the Acid Deposition Research Program

BIOPHYSICAL RESEARCH

MAJOR BIOPHYSICAL COMPONENTS OF ALBERTA (ACCOMPANIED BY 1:1,000,000 MAPS)

by

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(Accompanied by 1:1,000,000 Maps)

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EXECUTIVE SUMMARY

This study has provided inventory data and mapping at a scale of 1:1,000,000 for macroclimatic regions, physiographic subdivisions, bedrock geology, and vegetation cover of the entire Province of Alberta except Banff, Jasper, and Wood Buffalo National Parks. Surficial materials have been mapped at the same scale for most of the Province, excluding extensive areas in northern Alberta where detailed inventories are lacking. Soils are being mapped by another reviewer for the Acid Deposition Research Program (ADRP). Compilation of data on each of these major biophysical components of ecosystems of Alberta is important for evaluation of potential impacts of acid depositions on terrestrial and aquatic ecosystems.

Each bedrock formation in Alberta has been rated as to its potential buffering capacity for acid deposition. A 1:1,000,000 map of these ratings has been prepared. Areas with "Unlimited" buffering capacity occur where calcareous sedimentary rocks are abundant; on the other extreme areas with "Low to No" buffering capacity occur where relatively pure siliceous rocks (of sedimentary, igneous, and metamorphic origins) dominate. Rocks with both "Unlimited" and "Low to No" buffering capacity exist in northeast Alberta and in the Rocky Mountains and their Foothills. Throughout the remainder of the Province, bedrock formations are types which possess "High to Medium" or "Medium to Low" buffering capacity.

Twelve major Macroclimatic Regions have been recognized and mapped for the Province. These are: Short Grass Prairie, Mixed Grass Prairie, Fescue Prairie, Montane, Parkland, Alpine, and Boreal Ecoregions, with the Boreal Ecoregion being subdivided into 5 major subregions. Eleven Physiographic Regions, 58 Physiographic Sections, and 197 Physiographic Districts have been identified and mapped from available data. Seven major types of surficial materials have been mapped for much of the Province, generalized from available detailed inventory data mapped at larger scales. One hundred and thirty-four Vegetation Community Types have been identified and described throughout the Province. Many of these community types are restricted to, and are useful in, characterizing each of the 12 macroclimatic regions. Sixty-seven dominant plant species have been identified in all of the known community types of Alberta.

The Community Type analysis of the vegetation of Alberta has shown that major climatically-controlled subdivisions exist in the Subalpine, Montane, Parkland, and Boreal Uplands regions. It is presumed that this is also true in the other macroclimatic regions but analyses there are incomplete. Subdivisions of all macroclimatic regions should be identified and mapped before results from the literature and field studies can be accurately extrapolated to the rest of the Province.

Ecosystems as units are much more complex than the sum of their individual components. They are entities, in practical terms, and reflect distinct developments of the interactions of all their biological and physical components. Even one variable factor may alter the nature of the whole ecosystem, including its susceptibility to acid deposition. Prediction of potential impacts of acid deposition based on an analysis of each biophysical component alone will likely be inaccurate.

The inventory data and conclusions generated by this survey have led to two major recommendations. Both are aimed at producing a framework and mechanism for mapping and evaluating potential impacts of acid deposition on forest, non-forest, and agricultural systems of Alberta.

The first recommendation involves producing a biophysical inventory of the Province at the ecodistrict level. Mapping should be done at scales of 1:500,000 or 1:1,000,000. This inventory would produce the framework for the accurate extrapolation of "potential acid deposition impact" ratings established by other work.

The second recommendation involves the identification of factors and factor interactions thought to be important in establishing the sensitivity of Alberta ecosystems to acid deposition. All known and potentially significant factors or factor interactions should be identified (through the co-operative analyses of several scientists, including a climatologist, bedrock geologist/surficial materials/soils/mineralogist, field pedologist, plant ecologist, phytosociologist, and ecophysiologist), quantified, and applied to the ecodistricts of Alberta to establish tentative "potential acid deposition impact" ratings. Field verification of the sensitivity rating system and mapping should be conducted for a number of abundant and socioeconomically important ecodistricts. Once the field verification has been completed, the sensitivity rating system should be reviewed and revised.

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1. INTRODUCTION

The purpose of this component (Project #BS-1-56110) of the Acid Deposition Research Program (ADRP) has been to provide inventory information for macroclimatic, bedrock geologic, surficial materials, physiographic, and vegetation resources based upon existing information. All of these biophysical components of the terrestrial environment are presented at the common map scale of 1:1,000,000 for all of Alberta excepting Banff, Jasper, and Wood Buffalo National Parks.

The second aspect of this work has been to establish the rationale behind the future integration of these biophysical aspects of the environment along with soils into an integrated ecological (biophysical) framework. Further, the value of this ecological framework for use in predicting the potential impacts of acid deposition upon Alberta's major ecosystems was established. Co-operative effort is required to establish the direction for the integration of all biophysical aspects of the environment into an ecological framework for the Province of Alberta.

2. METHODS

2.1 MACROCLIMATE

Macroclimatic parameters and map delineations for the Province were taken from the work of Strong and Leggat (1981).

2.2 PHYSIOGRAPHY

Mapping and descriptions of the physiographic subdivisions of the Province were taken directly from the prepublication work of Pettapiece (1985).

2.3 BEDROCK GEOLOGY

Bedrock geology map delineations were taken directly from the work of Green (1972) for the areas of Alberta east of the Rocky Mountain Foothills. In the Rocky Mountains and Foothills, the map by Green does not allow mapping of basic lithological bedrock types and, therefore, other maps were used to identify the distribution of major lithological units. These maps are those by Ollerenshaw (1975), Price et al. (1973), Ollerenshaw (1978), and Okulitch and Woodsworth (1984).

All available maps referred to in selecting these five for use in this study are included as Appendix 7.1 as "References - Bedrock Geology."

An analysis and mapping of potential buffering capacity of bedrock formations to acid depositions was conducted. Each formation found in Alberta was rated as to its relative potential buffering capacity using the ratings established by Hendrey et al. (1980) and Shilts et al. (1981). These ratings are: (1) Unlimited, (2) High to Medium, (3) Medium to Low, and (4) Low to None. These categories include the following bedrock types:

1) Unlimited = limestones, dolomites, highly fossiliferous sedimentary and metamorphic equivalents;
2) High to Medium = slightly calcareous rocks, low grade intermediate to mafic volcanic rocks, ultramafic rocks, and glassy volanic rocks;
3) Medium to Low = sandstones, shales, conglomerates, or their metamorphic equivalents, high grade metamorphic felsic to intermediate volcanic rocks, intermediate igneous rocks, calcic-silicate gneisses (all without free carbonates);
4) Low to None = granites, syenite and their metamorphic equivalents, granitic gneisses, quartz sandstones and their metamorphic equivalents.

In cases where the mapping scale would not allow separate mapping of two or more formations which have different ratings, the range of ratings are shown for that delineation. In other cases, a range of potential buffering capacity ratings exist on the map because the formation in question possesses bedrock members with very different lithological compositons and, therefore, very different ratings within the mapped formation.

2.4 SURFICIAL MATERIALS

Surficial materials existing in Alberta were mapped using available published maps and reports. The maps ranged in scale from 1:63,360 to 1:253,440 and were generalized to the smaller scale of this mapping project (i.e., 1:1,000,000). Surficial material types which occupied less than 10% of any given generalized map delineation on the 1:1,000,000 map were excluded from the legend description. Only the most abundant surficial materials were included on this small-scale map.

The following studies were those used in the preparation of the small-scale 1:1,000,000 generalized map:

National Topographic System Map Area	Reference (Original Map Scale)
72 E	Westgate 1968 (1:250,000);
72 L	Berg and McPherson 1972 (1:250,000);
72 M	Kjearsgaard 1976 (1:126,720);
82 G	Stalker 1962a, Stalker 1959 (both 1:253,440);
82 H	Stalker 1962b (1:253,440);
82 I	Stalker 1957, Stalker 1965 (both 1:253,440);
82 J	Bayrock and Reimchen 1980 (1:250,000);
82 O	Bayrock and Reimchen 1980 (1:250,000);
82 P	Stalker 1973a (1:250,000);
73 D	Bayrock 1967 (1:63,350);
73 E	omitted (out-of-print maps unavailable);
73 L	Kocaglu 1975 (1:126,720);
73 M	unmapped;
83 A	Stalker 1960 (1:253,440) and Bowser et al. 1951 (1:190,080);
83 B	Peters and Bowser 1958 (1:126,720); Bayrock and Reimchen 1980 (1:250,000); Peters 1981 (1:126,720);
83 C	Bayrock and Reimchen 1980 (1:250,000); Peters 1981 (1:126,720);
83 E	Bayrock and Reimchen 1980 (1:250,000);
83 F	Dumanski et al. 1972 (1:126,720);
83 G	Twardy and Lindsay 1971 (1:126,720); Lindsay et al. 1968 (1:126,720);
83 H	Bowser et al. 1962 (1:126,720);
83 I	Kjearsgaard 1972 (1:126,720);
83 J	Wynnyk et al. 1969 (1:126,720);
83 K	Knapik and Lindsay 1983 (1:126,720);
83 L	Twardy and Corns 1980 (1:126,720);
83 M	Odynsky et al. 1956, 1961 (1:126,720); Odynsky and Newton 1950 (1:126,720);
83 N	Odynsky et al. 1952, 1956 (1:126,720); Odynsky and Newton 1950 (1:126,720);
83 O	unmapped;
83 P	unmapped;
74 D	Bayrock and Reimchen 1980 (1:250,000);
74 E	Bayrock 1971 (1:250,000);
74 L	Bayrock 1972a,b,c (1:250,000);
74 M	unmapped;
84 A	Bayrock and Reimchen 1974 (1:250,000);
84 B	unmapped;
84 C	Scheelar and Odynsky 1968 (1:126,720);
84 D	Reeder and Odynsky 1965 (1:126,720);
84 E	unmapped;
84 F	Reeder and Odynsky 1969 (1:126,720);
84 G	unmapped;
84 H	Bayrock 1971 (1:250,000);
84 I	unmapped;
84 J	Scheelar and Macyk 1972 (1:126,720);

84 K Scheelar and Macyk 1972 (1:126,720);
84 L unmapped;
84 M unmapped;
84 N unmapped;
84 O omitted;
84 P omitted.

All of these references and all others available and referred to are included as Appendix 7.2 (References - Surficial Materials).

2.5 VEGETATION

Two major analyses were conducted on the vegetation of Alberta. The first analysed all available literature describing the vegetation of Alberta. The references used in this analysis are included as Appendix 7.3 (References - Vegetation). A subset of this literature was selected which contained raw plot data with quantitative plot data showing cover of individual plant species. These 39 references were used to analyze quantitative species composition and cover values following the modified Braun-Blanquet phytosociological analysis methology (Mueller-Dombois and Ellenberg 1974). (These 39 references are identified in Appendix 7.3 by an "**" following the citation.) Available plots (totalling 2,056) were first placed into each ecoregion.
The plots were then ordered into floristic groupings based upon the character and differential species (defined in the technical sense of Mueller-Dombois and Ellenberg 1974). Cover values used are largely canopy coverage (Daubenmire 1959), except for plots in the Short Grass and Mixed Grass Prairie Ecoregions. In these cases cover values are basal area cover. The Braun-Blanquet analyses were conducted separately for all plots found within each ecoregion.

The second vegetation analysis task involved producing a vegetation map at 1:1,000,000 scale. This was conducted using Phase II Alberta Forest Service mapping in the Green Zone areas of the Province.
The original scale of this mapping was 1:31,680 but had been reduced to 1:100,000 scale. The 1:100,000 scale maps were used in this study and further generalized to the 1:1,000,000 scale. The minimum delineation size is approximately 1,295.5 ha. Phase III Alberta Forest Service mapping of the Green Zone was obtained in computer printout form giving the species composition information available from this most recent mapping on the township and range basis. The Phase III information was used to update the older Phase II map delineation descriptions for the areas presently covered by Phase III.

The vegetation cover of the White Zone (e.g., largely the cultivated portions of Alberta) was mapped into cleared and uncleared categories using the most recent LANDSAT satellite colour infrared images. Mapping was conducted on 1:1,000,000 base map using Bausch and Lomb Transferscope equipment at the Alberta Remote Sensing Centre, Edmonton. The LANDSAT images used in this part of the study include the following listed by Worldwide Reference System coordinates:

44-26	August 26, 1981,	ID #22408-17412;
43-26	September 12, 1981,	ID #22425-17352;
42-26	September 11, 1981,	ID #22424-17294;
45-25	September 14, 1981,	ID #22427-17462;
43-25	July 7, 1980,	ID #21993-17381;
41-25	September 24, 1983,	ID #40435-17533;

46-24	September 15, 1981,	ID #22428-17514;
45-24	September 14, 1981,	ID #22427-17460;
44-24	September 24, 1979,	ID #21706-17395;
43-24	July 2, 1981,	ID #22353-17353;
46-23	September 15, 1981,	ID #22428-17512;
46-22	September 15, 1981,	ID #22428-17505;
43-22	September 22, 1983,	ID #40433-18044;
41-23	June 14, 1984,	ID #50105-17512;
41-22	June 14, 1984,	ID #50105-17510; and
40-23	July 31, 1983,	ID #40380-17463.

The 1:1,000,000 vegetation map also includes map delineations showing the distribution of past fires from 1964-1984, inclusive. Individual maps of fire extent for each of these years was obtained from the Alberta Forest Service, Fire Research Division, Edmonton. These recent fire boundaries were transferred onto the 1:1,000,000 map for this study. Fire has been a major disturbance factor historically in all ecoregions of Alberta. Since about 1900 fire suppression has limited major fires largely to the Boreal Mixedwoods, Boreal Foothills, and Boreal Northlands Subregions of the Boreal Ecoregion. The areas mapped as recent fires possess vegetation cover, but such seral vegetation types have not been mapped. This mapping of major fires (i.e., those covering at least 1295 ha) which have occurred since 1964 gives a rough indication of the importance of this major disturbance factor across the Province.

Literature covering wetlands, riparian, and alpine vegetation of Alberta was omitted from this study. Riparian and alpine vegetation were not mapped on the 1:1,000,000 vegetation map as any attempt to do this would have resulted in an extremely complicated map. Wetland vegetation has been mapped into one group - "wetlands." Further refinement of wetland types, while important for future analysis of acid deposition research, is beyond the terms of reference of this study. Many studies exist on the fens, marshes, bogs, and muskegs of Alberta; however, for extensive areas in northern and central Alberta few studies exist. The intricate juxtaposition and wide diversity of wetland types precludes mapping these subtypes of wetlands at the 1:1,000,000 scale used in this study.

The cover values of each plant species are listed within each Community Type (CT) within the Results section of this report. For brevity each plant species has been assigned an acronym within the tables presented. These acronyms are identified in Appendix 7.4.

2.6 BIOPHYSICAL (ECOLOGICAL) CLASSIFICATION

Each of the previously discussed biophysical features of Alberta (i.e., climate, physiography, bedrock geology, surficial materials, soils, and vegetation) interact through time to produce unique ecosystems across the Province. The basic unit of ecosystems is the ecosite, which is defined as a unique combination of landform, parent materials, soils, and vegetation (Archibald et al. 1984). Ecosites are mappable at scales of 1:10,000 to 1:25,000. Ecosites are grouped into ecosections which form recurring patterns of slope, landform, soils, and vegetation. Ecosections are mapped at scales of 1:25,000 to 1:150,000. Ecosections in turn are grouped into ecodistricts which are based upon distinct physiographic and/or geologic patterns. Ecodistricts are biophysical subdivisions which possess similar patterns of relief, geology, physiography, and

surficial materials. Ecodistricts are mappable at scales of 1:200,000 to 1:500,000. At the broadest level of generalization in the hierarchical biophysical classification system are the ecoregions. Ecoregions are areas characterized by a distinctive regional climate as expressed by vegetation.

Ecoregions of Alberta have been defined and mapped (Halliday 1937; Rowe 1972; and Strong and Leggat 1981). Ecodistricts have not been characterized for the Province as yet. Ecosections and ecosites have been identified by many site-specific studies scattered throughout the Province.

Biophysical classification can provide the foundation for collecting and interpreting research results as well as for extrapolating management techniques to the appropriate new sites (Pfister and Arno 1980). Biophysical classification is based upon classification of the potential climax vegetation. Climax vegetation (in the polyclimax sense of Tansley 1935) reflects the overall environment as an integration of climate, topography, and soils. Biophysical classification, therefore, provides a permanent and ecologically based system of land classification that can be applied to both research and management. Thus, for the Acid Deposition Research Program a biophysical classification could serve to:

1) identify the major ecosystem types of Alberta and their biophysical characteristics (as itemized in Walmsley et al. 1980);
2) organize the available research results on acid deposition within this hierarchy of classification;
3) provide a framework for researching the impacts of acid deposition on the major ecosystems of Alberta; and
4) provide the foundation for predicting potential impacts on major Alberta ecosystems from the available literature and research.

3. RESULTS

3.1 MACROCLIMATE OF ALBERTA

Table 1 lists some of the important climatic parameters that have been summarized for the major ecoregions of Alberta (Strong and Leggat 1981). Within each of the ecoregions, each of these climatic parameters varies significantly in complex gradient patterns. These complex gradient patterns are poorly and incompletely understood at the present time. This situation is largely due to two factors: (1) a lack of long-term meteorological station measurements in high enough density throughout the entire Province; and (2) a lack of detailed analyses of the existing data to identify these patterns. Several workers have produced important analyses of this type for various portions of the Province. These works provide some insight into potential subdivisions of the major macroclimatic regions identified as ecoregions by Strong and Leggat (1981). Several studies have analysed the Short Grass, Mixed Grass, Fescue, and Parkland Ecoregions (Longley 1972; Powell 1977; and Powell and MacIver 1978). The Boreal Foothills, Boreal Uplands, and Subalpine Ecoregions have been analysed by Powell (1977). Boreal Mixedwoods and Boreal Foothills Ecoregions have received work by MacIver (1970), MacIver et al. (1972), Powell and MacIver (1976), and Powell and MacIver (1977). No work has been completed for the northern portions of the Boreal Mixedwoods, Boreal Foothills, Boreal Northlands, and Boreal Subarctic Ecoregions of the Province. The 1:1,000,000 scale map of "Vegetation of Alberta" includes the delineation of the major macroclimatic regions (ecoregions and subregions) as defined by Strong and Leggat (1981) and modified by Knapik and Westworth (1984), as well as refinements made during the course of this study.

3.2 PHYSIOGRAPHIC SUBDIVISIONS OF ALBERTA

A map of "Physiographic Subdivisions of Alberta" is included with this report. This map shows the distribution of the 11 physiographic regions, 58 physiographic sections, and 197 physiographic districts as defined by Pettapiece (1985). Table 2 lists each of these physiographic areas and the major landform types included within each district. Detailed analysis and incorporation of this physiographic data into a biophysical survey of Alberta must await the publication of the report being prepared by Pettapiece at the present time to accompany the map.

3.3 BEDROCK GEOLOGY OF ALBERTA

A map is included with this report showing the distribution of major bedrock lithological types throughout Alberta. Tables 3, 4, and 5 list each bedrock formation mapped by the studies used in this compilation of existing bedrock information.

Category 1 on the "Bedrock Geology of Alberta" map represents formations possessing unlimited capacity to reduce acidity of atmospheric depositions due to the rapid and complete reaction of H^+ ions with the calcareous minerals either making up the rock or forming the cementing agent for the sedimentary rock particles. The predominant minerals present in these rocks are calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), siderite ($FeCO_3$), and rhodochrosite ($MnCO_3$).

Category 2 on the map possesses medium to high capacity to reduce acidity of atmospheric depositions, again largely due to the presence of calcareous minerals. In

Table 1. Meteorological parameters of major ecoregions of Alberta.

Ecoregion	Mean Annual Temperature (°C)	Mean Annual Precipitation (mm)	Moisture Deficit (mm)	Frost Free Days	Growing Degree Days Above 5°C	Mean May-Sept Temperature (°C)	Mean May-Sept Precipitation (mm)
Short Grass Prairie	4.0	340	-300	115	1570	15.0	210
Mixed Grass Prairie	4.0	400	-240	110	1440	14.5	260
Fescue Prairie	3.5	520	-170	90	1210	12.5	290
Aspen Parkland	2.0	450	-160	95	1260	13.0	300
Montane	3.0	560	-160	75	1030	11.5	270
Subalpine	1.5	720	-140	15	810	9.5	320
Alpine	-4.5	730	-	-	-	6.5	360
Boreal Mixedwood	0.5	440	-190	85	1190	12.0	300
Boreal Foothills	2.0	570	- 70	80	1080	11.5	370
Boreal Uplands	1.0	580	- 20	75	740	10.0	380
Boreal Northlands	-3.5	340	-	85	1050	11.0	250
Boreal Subarctic	-	-	-	-	-	10.0	300

Source: Strong and Leggat 1981.

Table 2. Physiographic subdivisions of Alberta.

Regions (Map Legend Unit)	Section (Map Legend Unit)	District (Map Legend Unit)
Kazan Upland (A)	Tazin R. Upland (A1)	Tazin R. Upland (A1.0) Reid Hills (A1.1)
Athabasca Plain (B)	Harrison R. Plain (B1)	Harrison R. Plain (B1.1)
	Richardson Upland (B2)	Richardson Hills (B2.1)
Northern Plains (C)	Great Slave Plain (C1)	Yates L. Plain (C1.1) Buffalo R. Plain (C1.2) Knights Creek Plain (C1.3) Salt River Plain (C1.4) Lake Claire Plain (C1.5) Buckton Plain (C1.6) Embarras Plain (C1.7)
	Delta Plains (C2)	Athabasca Delta (C2.1) Big Slough Plain (C2.2)
Saskatchewan Plains (CD)	Methy Porage Plains (D1)	Steepbank Plain (D1.1) Garson Plain (D1.2)
	Firebag Hills Uplands (D2)	Firebag Plain (D2.1) Firebag Hills (D2.2) Muskeg Mountain (D2.3)
Northern Alberta Lowlands (E)	Fort Nelson Lowland (E1)	Hay River Plain (E1.1) Zama Lake Plain (E1.2) Hoohey Plain (E1.3)
	Vermilion Lowland (E2)	LaCrete Plain (E2.1) High Level Plain (E2.2) Mikkwa Plain (E2.3) Ponton Plain (E2.4) Boyer Plain (E2.5) Cache Plain (E2.6) Haro River Plain (E2.7)
	McMurray Lowland (E3)	Dover Plain (E3.1) Kearl Lake Plain (E3.2) Johnson Lake Plain (E3.3)
	Peace River Lowlands (E4)	Manning Plain (E4.1) Cadotte Plain (E4.2) Falher Plain (E4.3) Watino Plain (E4.4) Rycroft Plain (E4.5) Worsley Plain (E4.6) Bearhead Plain (E4.7) Sturgeon Plain (E4.8) Josephine Plain (E4.9) Boundary Lake Plain (E4.10) Cardinal Lake Plain (E4.11) Smoky Plain (E4.12) High Prairie Plain (E4.13) Peace River Valley (E4.14)

continued

Table 2 (Continued).

Regions (Map Legend Unit)	Section (Map Legend Unit)	District (Map Legend Unit)
Northern Alberta Lowlands (E)	Wabasca Lowland (E5)	Loon Lake Plain (E5.1)
		Bolton Plain (E5.2)
		MacKay Plain (E5.3)
		Algar Plain (E5.4)
		Wabasca Plain (E5.5)
		Brule Plain (E5.6)
		Athabasca Valley (E5.7)
Eastern Alberta Plains (F)	Lesser Slave Lowland (F1)	Lesser Slave Plain (F1.1)
		Pembina Plain (F1.2)
	Lac la Biche Plain (F2)	Wandering River Plain (F2.1)
		Beaver River Plain (F2.2)
		Elk Point Plain (F2.3)
		Owl River Plain (F2.4)
		North Saskatchewan Valley (F2.5)
	Snipe Lake Plain (F3)	Ribstone Plain (F3.1)
		Dillberry Plain (F3.2)
		Sibbald Plain (F3.3)
		Acadia Plain (F3.4)
	Bidstick Lake Plain (F4)	Cavendish Plain (F4.1)
		Walsh Plain (F4.2)
		Red Deer Valley (F4.3)
	Tawatinaw Plain (F5)	Thorhild Plain (F5.1)
		Cross Lake Plain (F5.2)
		Fawcett Plain (F5.3)
		Whitford Plain (F5.4)
		Redwater Plain (F5.5)
	Sullivan Lake Plain (F6)	Daysland Plain (F6.1)
		Castor Plain (F6.2)
		Sounding Creek Plain (F6.3)
		Berry Creek Plain (F6.4)
		Matzhiwin Plain (F6.5)
		Kininvie Plain (F6.6)
	Coulee Plain (F7)	Enchant Plain (F7.1)
		Etzilom Plain (F7.2)
		Fincastle Plain (F7.3)
		Pakowki Plain (F7.4)
	Edmonton Plain (F8)	Westlock Plain (F8.1)
		Lake Edmonton Plain (F8.2)
		Pipestone Plain (F8.3)
		Buffalo Lake Plain (F8.4)
	Big River Plains (F9)	Windfall Plain (F9.1)
		Ponoka Plain (F9.2)
		Drumheller Plain (F9.3)
		Blackfoot Plain (F9.4)

continued

Table 2 (Continued).

Regions (Map Legend Unit)	Section (Map Legend Unit)	District (Map Legend Unit)
Eastern Alberta Plains (F)	Mostoos Hills Upland (F10)	Christina Lake Plain (F10.1) Pinehurst Hills (F10.2) Mostoos Upland (F10.3)
	Thickwood Hills Uplands (F11)	Cold Lake Hills (F11.1) Frog Lake Upland (F11.2)
	Vermilion Uplands (F12)	Whitefish Upland (F12.1) Myrnam Upland (F12.2) Viking Upland (F12.3)
	Neutral Hills Uplands (F13)	Neutral Upland (F13.1) Provost Upland (F13.2)
	Rainy Hills Uplands (F14)	Oyen Upland (F14.1) Rainy Hills Upland (F14.2) Schultz Upland (F14.3)
	Churchill Uplands (F15)	Paddle River Plain (F15.1) Lac Ste. Anne Plain (F15.2) Glory Hills (F15.3) Dolberg Hills (F15.4)
	Cooking Lake Uplands (F16)	Beaver Hills Upland (F16.1) Bashaw Upland (F16.2) Rumsey Upland (F16.3) Crawling Valley Upland (F16.4) Lomond Upland (F16.5)
Western Alberta Plains (G)	Drayton Plain (G1)	Edson Plain (G1.1) Anselmo Plain (G1.2) Drayton Valley Plain (G1.3) Brazeau Plain (G1.4)
	Olds Plain (G2)	Crimson Lake Plain (G2.1) Medicine River Plain (G2.2) Rosebud Plain (G2.3) Strathmore Plain (G2.4)
	Southwest Plains (G3)	Little Bow Plain (G3.1) Three Rivers Plain (G3.2) Verdigris Plain (G3.3) Lost River Plain (G3.4) Sage Creek Plain (G3.5)
	Lodgepole Uplands (G4)	Cynthia Upland (G4.1) Bucklake Upland (G4.2)
	Drumheller Uplands (G5)	Delburne Upland (G5.1) Hand Hills (G5.2) Wintering Hills (G5.3)
	Blackfoot Uplands (G6)	Gladys Ridge (G6.1) Majorville Upland (G6.2) Vulcan Upland (G6.3)

continued

Table 2 (Continued).

Regions (Map Legend Unit)	Section (Map Legend Unit)	District (Map Legend Unit)
Northern Alberta Uplands (H)	Cameron Hills Uplands (H1)	Bisticho Plain (H1.1) Cameron Hills Upland (H1.2) Elsa Hill (H1.3) Bootis Hill (H4.1)
	Caribou Mountains Uplands (H2)	Melvin Plain (H2.1) Caribou Mountains (H2.2)
	Clear Hills Uplands (H3)	Rainbow Lake Plain (H3.1) Chinchaga Plain (H3.2) Notikewin Plain (H3.3) Milligan Hills (H3.4)
	Clear Hills Uplands (H3)	Bassett Hill (H3.5) Mount Watt (H3.6) Naylor Hills (H3.7) Clear Hills (H3.8)
	Buffalo Head Hills Uplands (H4)	Russell Lake Upland (H4.1) Wadlin Lake Upland (H4.2)
	Birch Mountains Uplands (H5)	McIvor Upland (H5.1) Birch Mountains (H5.2) Peerless Lake Upland (H5.3)
	Utikuma Uplands (H6)	Utikuma Plains (H6.1) Heart River Upland (H6.2) Pelican Mountains (H6.3) Amadou Hills (H6.4)
	Stony Mountain Uplands (H7)	Crow Lake Upland (H7.1) May Hills (H7.2)
Southern Alberta Plains (J)	Wapiti Plains (J1)	Blueberry Plain (J1.1) Beaverlodge Plain (J1.2) Pinto Plain (J1.3) Iosegun Plain (J1.4) Puskwaskau Hills (J1.5)
	Saddle Hills Upland (J2)	Saddle Hills (J2.1)
	Swan Hills Uplands (J3)	Snipe Lake Plain (J3.1) Driftpile Benchland (J3.2) Freeman Benchland (J3.3) Swan Hills (J3.4)
Southern Alberta Uplands (J)	Summit Benchlands (J4)	Simonette Benchland (J4.1) Little Smoky Benchland (J4.2) Mayberne Benchland (J4.3) Blue Ridge Benchland (J4.4)
	Grande Cache Benchlands (J5)	Cutbank Benchland (J5.1) Berland Benchland (J5.2) Kakwa Benchland (J5.3) Entrance Benchland (J5.4)

continued

Table 2 (Concluded).

Regions (Map Legend Unit)	Section (Map Legend Unit)	District (Map Legend Unit)
Southern Alberta Uplands (J)	Western Benchlands (J6)	Wolf Lake Benchland (J6.1) O'Chiese Benchland (J6.2) Crossfield Benchland (J6.3) Shunda Benchland (J6.4) Nosehill Benchland (J6.5) Okotoks Upland (J6.6)
	Porcupine Hills Upland (J7)	Porcupine Hills (J7.0)
	Cardston Plain (J8)	Cardston Plain (J8.0)
	Milk River Uplands (J9)	Milk River Ridge (J9.1) Milk River Plain (J9.2) Del Bonita Plateau (J9.3)
	Sweetgrass Upland (J10)	Sweetgrass Upland (J10.0)
	Cypress Hills Uplands (J11)	McAlpine Benchland (J11.1) Elkwater Benchland (J11.2) Cypress Hills Plateau (J11.3)
Rocky Mountain Foothills (L)	Northern Foothills (L1)	Northern Foothills (L1.0)
	Central Foothills (L2)	Central Foothills (L2.0)
	Southern Foothills (L3)	Southern Foothills (L3.0)
Rocky Mountains (M)	Front Ranges (M1)	Front Ranges (M1.0)
	Park Ranges (M2)	Park Ranges (M2.0)
	Border Ranges (M3)	Clark Range (M3.0)

Source: Pettapiece 1985.

Table 3. Potential buffering capacity rankings of bedrock formations found in central and southern Alberta to inputs of acid deposition.

Geological Age	Formation Name	Buffering Capacity Ranking**	Lithological Notes
Tertiary Pliocene	Hand Hills	2	Conglomerate in a sandy calcareous matrix, marl, quartzite embedded in hard calcareous cement.
Oligocene	Cypress Hills	2	Feldspathic sandstones and mudstone with abundant calcareous matrix.
Paleocene and Upper Cretaceous	Paskapoo	2	Calcareous, cherty sandstone, siltstone and mudstone with moderate free carbonate content.
	Ravenscrag	3	Feldspathic sandstones and mudstone.
Upper Cretaceous	Whitemud	3	Bentonitic sandstone and mudstone.
	Battle	3	Bentonitic mudstone with siliceous tuff beds.
	St. Mary River	2	Calcareous sandstone, siltstone, and mudstone; coquined limestone in basal part.
	Horseshoe Canyon, Upper	2	Fine-grained sandstone and siltstone in bentonitic matrix with moderate calcareous content also.
	Horseshoe Canyon, Mid and Lower	3	Fine-grained sandstone and siltstone in bentonitic matrix, low carbonate content but present consistently.
	Eastend	2	Feldspathic sandstone, silty and calcareous shale.
	Bearpaw	2	Soft shales with abundant proportions of lime, iron and aluminous contents in sediments.
	Belly River	2	Feldspathic sandstones, siltstone, and mudstone.
	Oldman	3	Feldspathic sandstones, clay, clayey silts.
	Foremost	2	Feldspathic sandstones, siltstone, mudstone, and shale; calcite matrix abundant.
	Pakowki	3	Shales with minor sandstone.
	Milk River	3	Feldspathic sandstone and shale with minor calcareous beds.

** 1 = Unlimited; 2 = High to Medium; 3 = Medium to Low

Table 4. Potential buffering capacity rankings of bedrock formations found in the Rocky Mountains and foothills of Alberta to inputs of acid deposition.

Geological Age	Formation Name	Buffering Capacity Ranking**	Lithological Notes
Paleocene	Porcupine Hills	2	Calcareous sandstone and mudstone
Paleocene and Upper Cretaceous	Willow Creek	2	Calcareous sandstone, bentonitic mudstone with abundant limestone concretions, minor limestone.
	Paskapoo	2	Calcareous, cherty sandstone, siltstone, and mudstone.
	Brazeau	4	Conglomerate and moderate to coarse-grained sandstone in siliceous matrix.
	Wapiti	3	Conglomerate, sandstone, carbonaceous shale and coal.
Upper Cretaceous	Wapiabi	2-3	Upper and lower members are shales with some sandstone beds, middle member is shale with some argillaceous or dolomitic limestone (=2).
	Cardium (S. area)	4	Quartzite sandstone, conglomerate, rare carbonates.
	Blackstone	3	Shale and dark sandstones, basal coarse sandstones.
	Puskwaskau	2	Partially calcareous shales with dolomitic beds.
	Bad Heart	3-4	Fine-grained sandstone, shale and some conglomerate.
	Muskiki	2	Shales, silty shale.
	Cardium (N. area)	3-4	Sandstones, some shales, cementation siliceous.
	Kaskapau	2	Shale, silty shale and siltstone; carbonaceous gypsiferous and carbonate fragments scattered in.
	Dunvegan	2	Sandstone, sandy shale with calcareous matrix in upper members and scattered in lower members.
	Ft. St. John Group	2	Shale, sandy shale with minor sandstone.
Lower Cretaceous	Blairmore	3-4	Sandstones and conglomerate with siliceous matrix.
	Kootenay	2-3	Carbonaceous sandstone, siltstone, shale, and coal.

continued

Table 4 (Concluded).

Geological Age	Formation Name	Buffering Capacity Ranking**	Lithological Notes
Lower Cretaceous	Nikanassin	2-3	Carbonaceous sandstone, siltstone, shale, and coal.
Jurassic	Fernie	2	Upper members of siltstone and shale, limestone and calcareous shale.
Triassic	Spray River	1	Limestone, dolomite, dolomitic sandstone, calcareous shale.
Permian and Pennsylvanian	Rocky Mountain	1-2	Sandstone, chert, dolomite, and dolimitic sandstone.
Mississippian	Rundle Group	1	Limestone, dolomite, calcareous shale.
	Banff	1	Limestone.
	Exshaw	1	Calcareous shale.
Devonian	Palliser	1	Limestone, dolomite.
	Alexo	1	Silty dolomite, limestone, sandstone, and dolomite breccia.
	Fairholme Group (and equivalents)	1	Limestone, dolomite, silty dolomite, and dolomite breccia.
Upper and Mid Cambrian	Elko, Lynx Group, etc.	1	Dolomite, dolomitic limestone.
	Flathead	3	Coarse-grained quartzitic sandstone.
Lower Cambrian	Gog Group	4	Quartzite, minor siltstone and shale.
PreCambrian	Miette Group, upper	3	Argillite and phyllitic shale, siltstone.
	Miette Group, middle	4	Coarse, arkosic sandstone.
	Miette Group, lower	2	Slatey shale, micritic limestone.
	Purcell Group; Kintla	4	Quartzite, sandstone (in upper member); dolomitic argillite, argillite (mid and lower member).
	Purcell; Sheppard	1	Dolomite, quartzite, siltstone and argillite.
	Purcell; Purcell lava	3	Andesite.
	Purcell; Siyeh	1	Dolomite and argillite.
	Purcell; Grinnell and Appekunny	3-4	Argillite, quartzite, siltstone.
	Purcell; Altyn and Waterton	1	Limestone, dolomite.

** 1 = Unlimited; 2 = High to Medium; 3 = Medium to Low; 4 = Low to None

Table 5. Potential buffering capacity rankings of bedrock formations found in northern Alberta (north of ca. 55° 30') to inputs of acid deposition.

Geological Age	Formation Name	Buffering Capacity Ranking**	Lithological Notes
Tertiary and Upper Cretaceous	Paskapoo	2	Calcareous, cherty sandstone, siltstone, and mudstone.
Upper Cretaceous	Wapiti	3	Conglomerate, sandstone, carbonaceous shale.
	Puskwaskua	2	Lower three members are partially calcareous shales with dolomitic beds, selenite and sideritic concretions.
	Bad Heart	4	Largely quartz sandstone.
	Kaskapau	2	Shales with significant beds of calcareous materials and sideritic concretions.
	Labiche	2	Shale and silty shale.
	Dunvegan	2	Sandstones and shales with abundant calcareous sandstones in the top beds and scattered in lower beds.
Upper and Lower Cretaceous	Shaftsbury	2-3	Shales, silty shales, ironstone, and bentonite.
Lower Cretaceous	Peace River	3	Quartzose sandstone, glauconitic sandstone.
	Loon River	2	Silty shale, siltstone.
	Grand Rapids	3	Quartzose and feldspathic sandstone, siltstone and shale.
	Clearwater	2	Silty shale, siltstone, cherty sandstone, and glauconitic sandstone.
	McMurray	3	Quartzose sandstone, siltstone, silty shale.
	Pelican	3	Fine-grained sandstone, silty and glauconitic in part.
	Joli Fou	2	Shale, silty beds in upper parts.
Upper Devonian	Grosmont	1	Dolomite.
	Mikkwa	1	Limestone, dolomitic limestone and shales.
	Ireton	2	Shale, calcareous shale, and siltstone.
	Waterways	1	Shale and argillaceous limestone with limestones interbedded.
	Hay River	1	Calcareous shale, argillaceous siltstone and limestone.
	Slave Point, Caribou Member	1	Limestone and dolomitic limestone, shale and gypsum.

continued

Table 5 (Concluded).

Geological Age	Formation Name	Buffering Capacity Ranking**	Lithological Notes
Mid Devonian	Slave Point, Ft. Vermilion Member	1	Gypsum, argillaceous and dolomitic gypsum; some limestone.
	Muskeg	1	Gypsum, anhydrite, some dolomite.
	Nyarling	1	Gypsum, anhydrite, dolomitic gypsum, limestone and dolomitic limestone.
	Keg River	1	Limestone, dolomite.
	Chinchaga	1	Dolomitic gypsum, anhydrite, dolomitic limestone.
	Fitzgerald	1	Dolomite, dolomitic limestone.
PreCambrian	Athabascan	4	Sandstone, local conglomerate, and shale beds.
	Archaen undivided	4	Metasedimentary rocks, quartzite, granite gneiss, quartz diorite, biotite granite and biotite schist.

** 1 = Unlimited; 2 = High to Medium; 3 = Medium to Low; 4 = Low to None.

addition, these rock types include sedimentary secondary rocks with calcareous matrices as cementing agents.

Category 3 includes formations which possess low to medium capacity to reduce acidity of atmospheric depositions. These rocks possess little or no calcareous minerals; instead, they are largely composed of alumino-silicate minerals of the more reactive types. These reactive types include such minerals as forsterite (Mg_2SiO_4), epidote ($Ca_2Al_3O\text{-}(SiO_4)(Si_2O_7)OH$), anorthite ($Ca(Al_2Si_2O_8)$), gibbsite ($Al(OH)_3$), and kaolinite ($Al_2Si_2O_5(OH)_4$).

Category 4 includes formations which possess low or no capacity to reduce acidity of atmospheric depositions. These rocks are largely composed of the relatively insoluble quartz mineral.

3.4 SURFICIAL MATERIALS OF ALBERTA

A map showing the distribution of the major surficial material genetic categories is included with this report. The categories recognized and mapped in this study include the following: till, glacio-fluvial and fluvial, glacio-lacustrine and lacustrine, alluvial, aeolian, colluvial, residual bedrock, and organic.

Till occupies the greatest area within the area presently mapped and is widespread throughout all portions of the Province. Glacio-fluvial and fluvial deposits occupy a much smaller area located often in elongated areas representing recent drainage channels or postglacial and/or interglacial drainage channels of various sizes. Glacio-lacustrine and lacustrine deposits occupy widely scattered areas throughout the mapped area and are most important in a few large areas. These areas include all mapped areas along the Peace River, the Valleyview and High Prairie regions, large areas in central Alberta from Edmonton south to Lethbridge, scattered large areas in the outer Foothills of the Rocky Mountains along their entire length, surrounding Fort McMurray, and smaller scattered areas in the prairie regions. Alluvial deposits occupy very small areas immediately adjacent to drainage channels. Large areas of aeolian deposits are found throughout the Province, especially south of Lake Athabasca and along the banks of major rivers. Colluvial deposits are largely confined to the Foothills and Rocky Mountains where they occupy extensive areas. Residual bedrock outcrops are found largely in the Rocky Mountains and along river banks. Large areas have also been recognized by various workers on the slopes of the Caribou Mountains, east of Hanna, south of Cypress Hills, and in several other smaller areas. Organic deposits are largely found in the northern half of the Province where surficial materials mapping is not available. (The vegetations map shows the distribution of organic deposits as they are distributed throughout the Province over these other surficial materials.)

3.5 VEGETATION OF ALBERTA

This analysis of the vegetation of Alberta is presented in two parts. The first describes the "Vegetation Community Types" identified from analysis of the existing published field plot data. The second deals with the mapping of existing vegetation cover throughout the Province and relates the information from the first section to the vegetation map. Therefore, the vegetation map produced by this study must be used in conjunction with the descriptive materials found in Section 3.5.1 to obtain as complete

as possible a description of species composition for each map delineation. Section 3.5.1 represents an extended legend for the map as a result.

3.5.1 Vegetation Community Types of Alberta

Table 6 lists each of the 134 vegetation community types (CT's) recognized throughout Alberta. This analysis excludes all community types found within the Alpine Ecoregion, all wetland community types, and all riparian community types. Many distinctive and unique community types are thus excluded. Rare and unique community types have also been excluded, largely because they occupy small areas of largely unknown extent. The community types which have been included represent the known types which occupy large areas. The community type names in Table 6 have been formed by combining the dominant species names into the compound forms on the Table.

3.5.1.1 Community Types of the Short Grass Prairie Ecoregion. The vegetation community types of the Short Grass Prairie Ecoregion are characterized by the presence of and dominance by Stipa comata, Bouteloua gracilis, and Agropyron smithii/A. dasystachyum. In alkaline parent materials dominance is often formed by Distichlis stricta and/or Sarcobatus vermiculatus. Table 7 lists the plant species and average percentage cover values for each of the major CT's identified in this ecoregion.

Disturbances such as grazing and fire cause large variability within each of these CT's. When disturbance is severe enough, basic changes in the biophysical features can occur which change a particular area into a different CT. This variability has not been dealt with by the present study.

3.5.1.2 Community Types of the Mixed Grass Prairie Ecoregion. The CT's of the Mixed Grass Prairie Ecoregion are characterized by the presence of and dominance by the same species found in the Short Grass Prairie Ecoregion. In addition, however, the Mixed Grass Ecoregion possesses, in the modal parent material sites, Stipa spartea, Festuca scabrella, and Agropyron caninum. Table 8 lists the dominant species and their average percentage cover values for each CT recognized.

Variations in each of these CT's produced by disturbances such as grazing and fire again have not been characterized.

3.5.1.3 Community Types of the Fescue Prairie Ecoregion. Table 9 lists each of the major CT's recognized by this study. Undisturbed examples of all CT's in this ecoregion are characterized by the presence of Festuca scabrella. Few other species are found in much abundance throughout the entire range of the ecoregion. Co-dominant species represent regional differences largely produced by climatic variability within the ecoregion. These regionally important species include Danthonia parryi, Festuca idahoensis, Elymus innovatus, Stipa spartea, and many others of lesser abundance. Regional variability in species composition and abundance represent as yet undefined "subregions" of this ecoregion.

Variations within each Community Type caused by disturbances have not been fully identified by this present study. Numerous researchers have identified community types which develop through disturbance (e.g., Johnston 1961; Smoliak et al. 1976; and Jaques 1979, 1980a).

Table 6. Listing of plant community types of Alberta.

A. SHORT GRASS PRAIRIE ECOREGION
1 = *Stipa comata-Bouteloua gracilis* Community Type (CT)
2 = *Artemisia cana/Stipa comata-Bouteloua gracilis* CT
3 = *Stipa comata-Calamovilfa longifolia* CT
4 = *Agropyron smithii-Stipa viridula* CT
5 = *Sarcobatus vermiculatus/Agropyron smithii* CT
6 = *Distichlis stricta* CT
7 = *Stipa comata-Agropyron smithii* CT

B. MIXED GRASS PRAIRIE ECOREGION
1 = *Stipa comata-Bouteloua gracilis-Agropyron dasystachyum* CT
2 = *Stipa spartea-Agropyron dasystachyum* CT
3 = *Stipa spartea-Bouteloua gracilis* CT
4 = *Stipa comata-Bouteloua gracilis* CT
5 = *Agropyron smithii-Stipa viridula* CT
6 = *Stipa comata-Agropyron smithii* CT

C. FESCUE PRAIRIE ECOREGION
1 = *Festuca scabrella-Stipa spartea* CT
2 = *Festuca scabrella-Danthonia parryii* CT
3 = *Festuca scabrella-Agropyron caninum* CT
4 = *Stipa comata-Bouteloua gracilis-Agropyron dasystachyum* CT
5 = *Stipa spartea-Agropyron caninum* CT
6 = *Festuca scabrella-Elymus* CT

D. PARKLAND ECOREGION - This ecoregion does not possess unique community types of its own; it is instead made up of a complex mosaic of community types from the Mixed Grass, Fescue Prairie, and Montane and Boreal Mixedwoods Ecoregions. The following community types are dominant: Mixed Grass Ecoregion = CT #1,2, and 3;
Fescue Prairie Ecoregion = CT #1 and 3;
Montane Ecoregion = CT #7 and 8;
Boreal Mixedwood Ecoregion = CT #1-3, 5-7, 11-14, and 25;
Boreal Foothills Ecoregion = CT #1, 9, 11, and 13-16

E. MONTANE ECOREGION
1 = *Pinus flexilis/Juniperus horizontalis* CT
2 = *Pinus flexilis/Arctostaphylos uva-ursi* CT
3 = *Pseudotsuga menziesii/Elymus innovatus* CT
4 = *Pseudotsuga menziesii-Pinus flexilis/Festuca scabrella-Danthonia parryii* CT
5 = *Pseudotsuga menziesii/Calamagrostis rubescens* CT
6 = *Picea glauca-Pseudotsuga menziesii/Calamagrostis rubescens* CT
7 = *Populus tremuloides/Rosa acicularis* CT
8 = *Populus tremuloides/Calamagrostis rubescens* CT
9 = *Picea glauca/Thuidium abietinum* CT
10 = *Picea glauca-Pseudotsuga menziesii/Hylocomium splendens* CT
11 = *Pseudotsuga/Rubus parviflorus* CT

F. SUBALPINE ECOREGION
1 = *Pinus contorta/Xerophyllum tenax* CT
2 = Hybrid *Picea-Abies lasiocarpa/Xerophyllum tenax* CT
3 = *Pinus contorta*-hybrid *Picea/Vaccinium membranaceum-Xerophyllum tenax* CT
4 = Hybrid *Picea/Rubus parviflorus* CT
5 = *Abies lasiocarpa*-hybrid *Picea/Clintonia uniflora* CT
6 = *Abies lasiocarpa-Pinus albicaulis/Xerophyllum tenax* CT
7 = *Larix lyallii-Abies lasiocarpa/Luzula hitchcockii* CT
8 = *Abies lasiocarpa*-hybrid *Picea/Pachystima myrsinites* CT
9 = *Pinus contorta/Arctostaphylos uva-ursi* CT
10 = *Pinus contorta/Elymus innovatus-Calamagrostis rubescens* CT
11 = *Pinus contorta/Vaccinium caespitosum* CT
12 = *Pinus contorta/Alnus crispa* CT
13 = *Pinus contorta*-hybrid *Picea/Hylocomium splendens* CT
14 = *Pinus contorta/Shepherdia canadensis/Vaccinium scoparium* CT

continued

Table 6. (Continued).

15 = *Pinus contorta/Shepherdia canadensis/Linnaea borealis* CT
16 = Hybrid *Picea/Equisetum arvense* CT
17 = Hybrid *Picea-Abies lasiocarpa/Equisetum arvense* CT
18 = Hybrid *Picea-Abies lasiocarpa/Hylocomium splendens* CT
19 = Hybrid *Picea-Abies lasiocarpa/Menziesia ferruginea* CT
20 = *Pinus contorta/Menziesia ferruginea* CT
21 = Hybrid *Picea-Abies lasiocarpa/Vaccinium scoparium* CT
22 = Hybrid *Picea-Abies lasiocarpa-Larix lyallii/Rhododendron albiflorum* CT
23 = Hybrid *Picea-Abies lasiocarpa-Pinus albicaulis/Menziesia ferruginea* CT
24 = Hybrid *Picea/Elymus innovatus* CT
25 = *Abies lasiocarpa*-hybrid *Picea/Vaccinium membranaceum-Rhododendron albiflorum* CT
26 = *Pinus contorta-Abies lasiocarpa*-hybrid *Picea/Vaccinium membranaceum-Rhododendron albiflorum* CT
27 = *Pinus contorta/Ledum groenlandicum* CT
28 = *Abies lasiocarpa*-hybrid *Picea/Ledum groenlandicum* CT
29 = Hybrid *Picea-Abies lasiocarpa/Phyllodoce glanduliflora* CT
30 = *Pinus contorta/Empetrum nigrum* CT
31 = Hybrid *Picea-Abies lasiocarpa/Vaccinium membranaceum* CT
32 = *Pinus contorta*-hybrid *Picea/Rhododendron albiflorum-Vaccinium membranaceum/Empetrum nigrum* CT
33 = *Pinus contorta/Vaccinium membranaceum/Empetrum nigrum* CT
34 = *Abies lasiocarpa/Vaccinium membranaceum/Phyllodoce empetriformis* CT
35 = Hybrid *Picea/Salix barclayi* CT
36 = *Abies lasiocarpa*-hybrid *Picea/Shepherdia canadensis-Salix barclayi* CT
37 = *Pinus contorta/Vaccinium membranaceum/Cornus canadensis* CT
38 = *Abies lasiocarpa*-hybrid *Picea/Rhododendron albiflorum-Vaccinium membranaceum/Phyllodoce empetriformis* CT

G. BOREAL UPLANDS ECOREGION
1 = *Picea mariana/Vaccinium membranaceum/Ledum groenlandicum* CT
2 = *Pinus contorta/Vaccinium membranaceum/Ledum groenlandicum* CT
3 = *Pinus contorta/Ledum groenlandicum/Pleurozium schreberi* CT
4 = *Pinus contorta/Vaccinium membranaceum-Vaccinium myrtilloides/Ledum groenlandicum* CT
5 = *Pinus contorta/Alnus crispa/Rubus pubescens* CT
6 = *Pinus contorta/Alnus crispa/Ledum groenlandicum* CT
7 = *Pinus contorta/Streptopus/Pleurozium schreberi* CT
8 = Hybrid *Picea-Abies lasiocarpa/Vaccinium membranaceum/ Hylocomiumsplendens* CT
9 = *Abies balsamea-Picea glauca/Rubus pubescens* CT
10 = *Picea glauca-Pinus contorta/Viburnum edule/Hylocomium splendens* CT

H. BOREAL FOOTHILLS ECOREGION
1 = *Pinus contorta-Picea glauca/Vibernum edule/Aralia nudicaulis* CT
2 = *Pinus contorta/Alnus crispa* CT
3 = *Picea glauca-Abies lasiocarpa/Cornus canadensis/Hylocomium splendens* CT
4 = *Picea glauca-Abies balsamea/Cornus canadensis/Hylocomium splendens* CT
5 = *Pinus contorta-Picea mariana/Ledum groenlandicum/Cladonia mitis* CT
6 = *Picea mariana-Pinus contorta/Ledum groenlandicum/Pleurozium schreberi* CT
7 = *Picea mariana/Hylocomium splendens* CT
8 = *Larix laricina/Betula glandulosa/Sphagnum* CT
9 = *Picea glauca/Equisetum arvense* CT
10 = Hybrid *Pinus contorta* x *P. banksiana//Alnus crispa* CT
11 = *Pinus banksiana/Arctostaphylos uva-ursi* CT
12 = *Pinus banksiana-Picea glauca/Alnus crispa/Pleurozium schreberi* CT
13 = *Populus balsamifera/Vibernum edule/Calamagrostis canadensis* CT
14 = *Populus tremuloides/Calamagrostis canadensis* CT
15 = *Picea glauca/Calamagrostis canadensis* CT
16 = *Picea glauca/Vibernum edule* CT

continued

Table 6. (Concluded).

I. BOREAL MIXEDWOOD ECOREGION
1 = *Populus tremuloides/Vibernum edule/Rubus pubescens* CT
2 = *Populus tremuloides–Populus balsamifera/Vibernum edule–Cornus stolonifera* CT
3 = *Populus tremuloides/Corylus cornuta/Aralia nudicaulis* CT
4 = *Populus tremuloides–Populus balsamifera/Rubus parviflorus* CT
5 = *Populus tremuloides/Calamagrostis canadensis* CT
6 = *Populus tremuloides/Equisetum arvense* CT
7 = *Populus tremuloides–Picea glauca/Shepherdia canadensis/Cornus canadensis* CT
8 = *Populus tremuloides–Betula papyrifera/Vaccinium myrtilloides* CT
9 = *Populus tremuloides–Picea glauca/Alnus crispa/Pleurozium schreberi* CT
10 = *Populus tremuloides–Picea glauca/Alnus tenuifolia–Vaccinium myrtilloides* CT
11 = *Picea glauca–Populus tremuloides/Calamagrostis canadensis* CT
12 = *Populus balsamifera/Cornus stolonifera* CT
13 = *Populus balsamifera/Alnus tenuifolia/Equisetum arvense* CT
14 = *Picea glauca/Vibernum edule/Calamagrostis canadensis* CT
15 = *Picea glauca/Alnus tenuifolia/Pleurozium schreberi* CT
16 = *Picea glauca/Rosa acicularis/Elymus innovatus* CT
17 = *Abies balsamea–Picea glauca/Calamagrostis canadensis* CT
18 = *Populus tremuloides/Festuca ovina/Cladonia* CT
19 = *Pinus banksiana/Vaccinium myrtilloides/Arctostaphylos uva-ursi* CT
20 = *Pinus banksiana/Vaccinium myrtilloides/Cladonia mitis* CT
21 = *Pinus banksiana/Ceratodon* CT
22 = *Pinus banksiana/Arctostaphylos uva-ursi/Cladonia mitis* CT
23 = *Pinus banksiana–Picea mariana/Ledum groenlandicum/Pleurozium schreberi* CT
24 = *Pinus contorta/Vaccinium myrtilloides/Cladonia mitis* CT
25 = *Pinus contorta/Vibernum edule/Aralia nudicaulis* CT
26 = *Pinus contorta–Picea mariana/Ledum groenlandicum/Pleurozium schreberi* CT
27 = *Picea mariana–Pinus contorta/Ledum groenlandicum/Pleurozium schreberi* CT
28 = *Picea mariana/Ledum groenlandicum* CT
29 = *Picea mariana/Sphagnum* CT
30 = *Picea mariana–Larix laricina/Ledum groenlandicum* CT
31 = *Larix laricina–Picea mariana/Ledum groenlandicum–Betula glandulosa* CT

J. BOREAL NORTHLANDS ECOREGION
1 = *Picea glauca/Hylocomium splendens* CT
2 = *Picea mariana/Ledum groenlandicum/Hylocomium splendens* CT
3 = *Picea glauca–Picea mariana/Ledum groenlandicum/Hylocomium splendens* CT
4 = *Picea mariana–Larix laricina/Ledum groenlandicum* CT
5 = *Populus tremuloides/Shepherdia canadensis/Arctostaphylos uva-ursi* CT
6 = *Populus tremuloides/Vibernum edule* CT
7 = *Abies balsamifera–Picea glauca/Hylocomium splendens* CT
8 = *Picea glauca/Calamagrostis canadensis/Rubus idaeus* CT

K. BOREAL SUBARCTIC ECOREGION
1 = *Picea glauca/Equisetum arvense* CT
2 = *Picea mariana/Hylocomium splendens* CT
3 = *Picea mariana/Ledum groenlandicum* CT
4 = *Picea mariana/Sphagnum* CT
5 = *Picea mariana–Populus tremuloides/Hylocomium splendens* CT

Table 7. SHORT GRASS PRAIRIE ECOREGION - Vegetation composition and average basal area cover (%) of species for common Community Types.

Species[1]	Community Type [2]						
	1	2	3	4	5	6	7
Arca		1	7	+	+		
Eula				1			
Roar		+					
Bogr	+	5	+	+	1		2
Stco	2	6	10	1	+		3
Agsm/Agda	1	1	4	14	6	4	2
Kocr	+	1	5	3	+	+	1
Ca spp.	+	1	+	1	+	1	+
Capr				1			
Calo		2	4				
Cafi	+						+
Camo	+	+					+
Dist					+	8	
Stvi				4	+		
Posa	1	+					
Po spp.				+		+	+
Agsc				1			
Juba				+		+	
Punu					+	+	
Save					2	1	
Atnu					+	+	
Sede	10				5	5	
Arfr	+	1	+	+	+	+	+
Psla			4				

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
\+ Cover less than 0.7%.

Plot data from: Clarke et al. (1942); Moss (1944); Keith (1958); Coupland (1961); DeVries (1968); Lodge et al. (1971); Smoliak et al. (1972, 1974, 1979); Wallis (1976); and Jaques (1977).

Table 8. MIXED GRASS PRAIRIE ECOREGION - Vegetation composition and average basal area cover (%) of species for common Community Types.

Species[1]	Community Type [2]					
	1	2	3	4	5	6
Arca					+	
Roar			+			
Bogr	25	4	2	+	+	2
Stco	15	1	1	2	1	3
Agsm/Agda	12	20	1	1	14	2
Kocr	12	9	1	+	3	1
Camo				+		+
Stvi	3	2			4	
Posa			+	1		
Poa spp.		6				
Agca	+	+	+			
Stsp	2	9	2			
Feid	1	+				
Fesc		+	1			
Caob	2	4	+			
Cast	+	3	+			
Agsc					1	
Sede				10		
Arfr			2	+	+	+
Syoc			+			

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
+ Cover less than 0.7%.

Plot data from: Clarke et al. (1942); Moss (1944); Keith (1958); Coupland (1961); DeVries (1968); Smoliak et al. (1972, 1974, 1979); and Wallis (1976).

Table 9. FESCUE PRAIRIE ECOREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type [2]					
	1	2	3	4	5	6
Bogr				25	4	
Stco				15	1	
Kocr	+	1	1	12	9	+
Stvi			+	3	2	
Agda	3	+		12	20	+
Agca	+	3	2	+	+	+
Stsp	2		12	2	9	
Feid		5		1	+	
Fesc	3	8	20	+	+	9
Caob	1	1	3	2	4	2
Dapa		6				
Dain		+	+			+
Brin		+	+			+
Cahe	1		+			
Poa spp.		+	+			1
Heho		+	+			
Stri		+				
Getr	+	4	1			
Roac/Rowo	1	+				+
Arfr	+	+	+			
Luse		3				
Syoc	+					
So spp.	+	2	+	+	+	
Gabo		1	+			+
Elin						1
Oxse						3

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
+ Cover less than 0.7%.

Plot data from: Moss (1932, 1944); Moss and Campbell (1947); Coupland (1961); Johnston (1961); Lopoukhire (1970); Lodge et al. (1971); Stringer (1973); Bailey and Anderson (1978); Jaques (1979, 1980a); and Smoliak et al. (1979).

3.5.1.4 Community Types of the Montane Ecoregion. Table 10 lists the eleven CT's recognized within the Montane Ecoregion. The presence in climax stands of the trees Pseudotsuga mensiezii and Pinus flexilis characterizes the CT's of this ecoregion. However, extensive stands of grasslands of numerous CT's from the Fescue Prairie Ecoregion often dominate areas of this ecoregion. These stands do not properly serve to define the limits of the Montane Ecoregion but rather serve to illustrate the complex interfingering of the two ecoregions caused primarily by physiographic heterogeneity. Regional variability exists within the Montane Ecoregion and could be used to define "subregions" based upon major climatic variability within the ecoregion. This work must await future analyses.

Major variability within each CT described here exists largely due to past fires. Grazing also secondarily produces plant composition and cover changes within each CT. Almost no work exists to adequately describe this variability within Alberta except in an incomplete and subjective way. The Montane Ecoregion in Alberta occupies five distinct geographic areas. These are: (1) Crowsnest Pass south to Waterton Lakes National Park; (2) the Porcupine Hills and surrounding areas; (3) the Bow River Valley; (4) the North Saskatchewan Valley; and (5) the Athabasca River Valley.

3.5.1.5 Community Types of the Parkland Ecoregion. The Parkland Ecoregion possesses no known unique vegetation community types. Rather, it is composed of a complex mosaic made up of community types common in the ecoregions which impinge upon it. These are the Fescue Prairie, Montane, Boreal Mixedwoods, Boreal Foothills, and Boreal Uplands Ecoregions. The CT's from each of these ecoregions which contribute to the diversity of the Parkland Ecoregion are listed on Table 6. Three broad "subzones" are tentatively recognized within the Parkland Ecoregion. These progress from driest and warmest on the south to wettest and coldest on the north.

Jaques (1980b) has discussed details of the vegetation changes which occur across this gradient. Basically, the southern and eastern most areas possess open fescue grassland stands interspersed with copses of aspen within the most moist microsites. This subregion has been termed the Aspen Groveland Subregion (Strong and Leggat 1981) and is here recognized as a classification unit. The next subregion, progressing north and west, is termed the Aspen Subregion. This subregion is characterized by the dominance of aspen and some balsam poplar in the wettest microsites, however, conifers are absent. The third subzone is the Mixedwood Subregion - aspen, and balsam poplar are roughly co-dominant and conifers are also co-dominant. As one progresses through the Aspen and Mixedwood Subregions from south to north, white spruce is the first conifer to appear, followed by lodgepole and jack pine. Once black spruce and tamarack appear, one begins to encounter the Boreal Forest Ecoregion.

3.5.1.6 Community Types of the Subalpine Ecoregion. The Subalpine Ecoregion has received probably the greatest amount of study of any ecoregion in Alberta. As a result, our knowledge of the community types found within it is probably the most complete. Table 11 lists the major species and their average cover values for each of the community types recognized in this study. These community types are distributed throughout Alberta in a complex way relating largely to major climatic influences on the distribution of the dominant plant species.

Table 10. MONTANE ECOREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type [2]										
	1	2	3	4	5	6	7	8	9	10	11
Trees:											
Pifl	10	34		4							+
Psme	2	+	21	4	57	3				18	60
Pigl			2			66	1		33	28	+
Pico			8		11	1			3	3	+
Potr		+	+		+	+	65	80			+
Shrubs:											
Ro spp.	1	2	7	+	3	2	7	4	2	1	
Shca	+	2	8		+				1	1	12
Syal	+		3								
Aruu	5	55	88	+	+		2		1		
Juho	19	2	7	5							
Amal		2	3				2	+			
Riox			1		+	1	2				
Juco	2			+						2	
Splu			5		1	1	1	3			
Sabe							2				
Syoc							2	2			
Forbs:											
Coco						3				3	
Libo			8		+	3			6	3	
Arco										2	20
Asco	1	10	4	1	5	3		5		1	
Gabo	1		2	+	2		3	5			
As spp.		1	8								
Asla		10	1								8
Anpa		1		+				+			
Frvi			7		1			4			
Epan					2	2	7	5			15
Laoc					3	2	3	6			
Thve					1		4	5			20
Luse							4	3			
Viam							3				
Grasses and Sedges:											
Agsm/Agda	2	3	1	+							
Agsp	+			+							
Caru		1	10		4	3		5			
Fesc		2	1	3							
Feid	+			2			3				
Agca		3		+		1	1	3			

continued...

Table 10 (Concluded).

Species[1]	Community Type [2]										
	1	2	3	4	5	6	7	8	9	10	11
Elin		6	66		2	1	1	+	6	+	
Po spp.		3	10				+				
Dapa				6							
Bere											5
Rupa											18
Acgl											10
Caob				+							
Elca								6			
Cryptogams:											
Hysp									7	58	
Plsc									3	6	
Thab									53	1	
Ptcc										6	
Peap										4	

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
\+ Cover less than 0.7%.

Plot data from: Lopoukhire (1970); Stringer and LaRoi (1970); Duffy (1971); Ogilvie (1971); Runge (1973); Fredrickson (1975); Kondla (1978); Jaques (1980a); and Holland and Coen (1982).

Table 11. SUBALPINE ECOREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]							
	1	2	3	4	5	6	7	8
Trees:								
Pico	60	+	30	10	+			
Pigl								
PiglXen	+	30	20	60	15	+		35
Abla		20	+	+	35	30	10	35
Pial					+	20		
Laly							40	
Potr								
Psme								
Poba								
Shrubs:								
Shca		8						
Acgl	+							
Bere	5				5			10
Alcr		10	15	10		3		
Vame		+	10			18	15	15
Rivi		8						
Vamrt		+						
Vasc		+	10				15	
Splu	10	5			10			10
Mefe			35			15	20	
Rhal		+						
Loin				10				
Sosi						3		
Pamy								20
Juco								
Aruu								
Roac								
Amal								
Legr								
Safa								
Sagl								
Vaca								
Phem								
Phgl								
Emni								
Cate								
Sasc								
Saba								

continued...

Table 11 (Continued).

Species[1]	Community Type[2]							
	1	2	3	4	5	6	7	8
Forbs:								
Rupa	15	10		15	18			10
Arco	10	10	10	15	5	15		
Thve	15	20	10	25	10			8
Epan	10	5						
Xete	30	25	15			30	15	
Asla			2					
Smst				10				
Clun					8			
Hela				10				
Hecy					4			
Vees						5		
Erpe						+	+	
Vasi						+	+	
Arla						20	10	
Asco							8	
Libo								
Frvi								
Laoc								
Hesu								
Pyse								
Pyas								
Coca								
Vavi								
Mepa								
Pe spp.								
Eqar								
Eqpr								
Eqsc								
Pepa								
Minu								
Rupe								
Arla								
Lyan								
Luno								
Vigl								
Asfo								
Trla								
Pafi								

continued...

Table 11 (Continued).

Species[1]	Community Type[2]							
	1	2	3	4	5	6	7	8
Grasses and Sedges:								
Luhi	+						10	30
Elin								
Caru								
Caco								
Feal								
Cryptogams:								
Hysp								
Plsc								
Di spp.								
Ptcc								
Pe spp.								
Cl spp.								
Mn sp.								
Baly								
Poju								
Drre								
Toni								

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	9	10	11	12	13	14	15	16	17	18
Trees:										
Pico	32	68	38	43	28	35	34			+
Pigl	1		+							
PiglXen		3		2	12	+	2	41	40	33
Abla	+			+	+			+	8	13
Pial										
Laly										
Potr	+	1					+			
Psme		1								
Poba								+	3	
Shrubs:										
Shca	6		7	2	+	24	16	1		+
Acgl										
Bere										
Alcr		+		23						
Vame										
Rivi										
Vamrt										
Vasc						42	+			5
Splu	+	1	1	1						
Mefe										
Rhal										
Loin								1		
Sosi										
Pamy										
Juco	7	4	1	1	+	+				
Aruu	27	2	6	4		2				
Roac	+	2	1	1	+	+		6		
Amal		+								
Legr		+	1	+						
Safa			1							
Sagl			2							
Vaca			17							
Phem										
Phgl										
Emni										
Cate										
Sasc										
Saba										
Vied								1		

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	9	10	11	12	13	14	15	16	17	18
Forbs:										
Rupa										
Arco		4	1	3	1	5	2			
Thve										
Epan		1		1		1	+			
Xete										
Asla										
Smst										
Clun										
Hela										
Hecy										
Vees										
Erpe										
Vasi										
Arla										
Asco	+	11	2	4	3	2				
Libo	6	10	8	7	5	7	15	3	2	+
Frvi	+	1	2							
Laoc	1	1								
Hesu	1									
Pyse		1			1					
Pyas				+						
Coca		1	3	3	2	+	+	2	+	5
Vavi				1						
Mepa				+	1				1	
Pe spp.								3		
Eqar								38	25	
Eqpr								9	2	
Eqsc								3		
Pepa				+						
Minu									2	
Rupe										
Arla										
Lyan										
Luno										
Vigl										
Asfo										
Trla										
Pafi										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	9	10	11	12	13	14	15	16	17	18
Grasses and Sedges:										
Luhi										
Elin	10	20	6	9	1	8	10			
Caru		11	4							
Caco			+							
Feal										
Cryptogams:										
Hysp	5	21	3	19	36	7	16	27	46	47
Plsc	3	1	12	13	32	22	24	10	14	17
Di spp.	1						+			+
Ptcc		1		4	5	3	2	1	3	3
Pe spp.			5	1	2	3	1	+	3	3
Cl spp.			7	+		+	2		+	2
Mn sp.								5		
Baly										
Poju										
Drre										
Toni										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	19	20	21	22	23	24	25	26	27	28
Trees:										
Pico	1	50	+	+	1	4	2	26	42	5
Pigl										
PiglXen	27	10	14	10	14	32	18	2	1	14
Abla	17	3	13	15	12	+	38	5	3	30
Pial				+	16					
Laly				15	+					
Potr										
Psme										
Poba										
Shrubs:										
Shca						3				
Acgl										
Bere										
Alcr							+			
Vame					3		14	7		
Rivi										
Vamrt	3	4	6	+	4					
Vasc	10	12	26	12	26		1		2	3
Splu										
Mefe	67	85		+	31		4	33		
Rhal	3	1	+	20	4		12	18		
Loin							1			
Sosc								1		
Pamy										
Juco						3				
Aruu						2				
Roac										
Amal										
Legr					3				22	16
Safa										
Sagl										
Vaca									2	+
Phem				1						
Phgl				+	1		1			
Emni					5				+	
Cate										
Sasc										
Saba										
Vied										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	19	20	21	22	23	24	25	26	27	28
Forbs:										
Rupa										
Arco						4	1		+	
Thve										
Epan							+			
Xete										
Asla										
Smst										
Clun										
Hela										
Hecy										
Vees										
Erpe				+						
Vasi				+			1			
Arla							1	4		
Asco										
Libo	+	+	+			6	+		3	2
Frvi										
Laoc										
Hesu						3				
Pyse									1	
Pyas										
Coca	+	+	+				2	4	5	5
Vavi					1			1	10	2
Mepa										
Pe spp.										
Eqar										
Eqpr										
Eqsc	1	+								
Pepa										
Minu										
Rupe							3	8	4	3
Arla										
Lyan								2	3	2
Luno							+			
Vigl										
Asfo										
Trla										
Pafi										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	19	20	21	22	23	24	25	26	27	28
Grasses and Sedges:										
Luhi										
Elin						13			4	
Caru										
Caco										
Feal										
Cryptogams:										
Hysp	27	10	8		14	4	15	6	27	43
Plsc	30	8	10	+	15	+	18	20	30	22
Di spp.			3	1	3		7		+	+
Ptcc	7	+			1		10	22	3	1
Pe spp.	4	3	3	+	3	+	1		2	+
Mn sp.										
Baly				3						
Cl spp.					2		1	11		
Poju										
Drre										
Toni										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	29	30	31	32	33	34	35	36	37	38
Trees:										
Pico		26	+	35	65		5	3	61	+
Pigl										
PiglXen	27	5	38	10	+	+	9	8	2	26
Abla	13	+	12	3	+	10	+	9	5	28
Pial										
Laly										
Potr										
Psme										
Poba										
Shrubs:										
Shca			1	6	4	6	1	19	6	
Acgl										
Bere										
Alcr										
Vame			6	11	25	6		3	15	16
Rivi										
Vamrt										
Vasc	12	1								
Splu										
Mefe				5	+	1				10
Rhal				14	5	3			8	34
Loin			4							
Sosc				1	+					1
Pamy										
Juco										
Aruu										
Roac			1							
Amal										
Legr										
Safa										
Sagl										
Vaca		4		1	7	2	10 2	1 8	11	
Phem						14				6
Phgl	15	2								
Emni	2	20	1	25	9				11	1
Cate	3									
Sasc					3			3		
Saba							15	12	2	
Vied										

continued...

Table 11 (Continued).

Species[1]	Community Type[2]									
	29	30	31	32	33	34	35	36	37	38
Forbs:										
Rupa										
Arco										
Thve							1	4		
Epan						3	1	9	3	1
Xete										
Asla										
Smst										
Clun				5						
Hela										
Hecy										
Vees										1
Erpe										
Vasi				1	+			1		1
Arla				4	3		1		2	3
Asco										
Libo					7				2	
Frvi							4	2		
Laoc								2		
Hesu										
Pyse			1						1	
Pyas										
Coca			2	16	1	1	2	3	32	3
Vavi		2								
Mepa			1		1			4		
Pe spp.										
Eqar			2				5		4	
Eqpr										
Eqsc										
Pepa			2				1		3	
Minu			1				2			
Rupe				2			1		10	3
Arla										
Lyan										
Luno				1	+			1		
Vigl				1	1					
Asfo							6	5		
Trla							4			
Pafi							4			

continued...

Table 11 (Concluded).

Species[1]	Community Type[2]									
	29	30	31	32	33	34	35	36	37	38
Grasses and Sedges:										
Luhi										
Elin										
Caru										
Caco										
Feal						5				
Cryptogams:										
Hysp	13	2	22	3				+	13	
Plsc	25	5	15						4	
Di spp.		3	5				20			+
Ptcc			8	4	2			1		7
Pe spp.	4		4			1				
Cl spp.	+	6	2	5	5	3		2		6
Baly										
Poju					2			1		
Drre						3	11			
Toni							13			

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
\+ Cover less than 0.7%.

Plot data from: Lopoukhine (1970); Jaques (1976a, 1978, 1980a); Ogilvie (1976); Kondla (1978); La Roi and Hratiuk (1980); Holland and Coen (1982); and Archibald et al. (1984).

The Subalpine Ecoregion is characterized in a broad way floristically by the presence of subalpine fir (Abies lasiocarpa) and hybrid white-Engelmann spruce (Picea glauca x P. engelmannii). Generally this introgression occurs above 1311 m elevation in the southern portion of the Province; hybrids exhibiting dominance by white spruce occurs between 1311-1829 m; hybrids exhibiting dominance by Engelmann spruce occur between 1524-1829 m; hybrids approaching pure Engelmann spruce occur from 1677 m to timberline. Subalpine fir is rare below 1524 m and only reaches co-dominance in climax stands above 1829 m; above 1982 m subalpine fir is often the dominant conifer to the exclusion of all others. Typical composition gradients show that subalpine fir comprises 35% of the number of stems in climax forest stands from 1524-1829 m; from 1829-1982 m, 50%; and above 1982 m, 75-100% (Horton 1956).

At present it is possible to recognize nine subregions within the limits of the Subalpine Ecoregion. These are based upon the altitudinal changes exhibited by the dominant overstory tree species as described above. The lowest altitudinal subzone is characterized by the general absence of subalpine fir and the dominance of hybrid spruce genetically close to pure white spruce (Daubenmire 1974). The middle altitudinal subzone is characterized by the subdominant presence of subalpine fir and the dominance by hybrid spruce intermediate between the two species. The third and highest elevation subzone is characterized by the presence of hybrid spruce approaching pure Engelmann spruce and the dominance of stands by subalpine fir.

Each of these three altitudinal subregions can be subdivided into latitudinal variations. These latitudinal variations are less well defined than the altitudinal ones but are no less important. A southern latitudinal subregion occurs from about Dutch Creek south through Waterton Lakes National Park. It is characterized by the presence of CT's #1-8 on Table 11. A northern latitudinal subregion occurs from about the North Saskatchewan River to the Wapiti River area and is characterized by the presence of CT's #31-38 on Table 11. The central latitudinal subregion is best characterized by the absence of the CT's listed for both the southern and northern subregions. However, CT's #10 and 11 are largely limited to the central subregion.

Major meso-climatic variability is likely responsible for these major differences in species composition and dominance described for all these CT's. Additional complexity and diversity of CT's is found throughout each of these subregions of the Subalpine Ecoregion based upon variability in topography, parent materials, and fire history. At present, the interactions of these three additional factors are poorly understood as related to major meso-climatic variability throughout the entire Subalpine Ecoregion.

Many of the CT's recognized on Table 11 represent seral CT's which are regenerating into another CT after past burning. These CT's are recognized even though they do not represent climatic climax CT's because they often cover very extensive areas throughout the Subalpine Ecoregion area. These seral CT's include the following: #1, 3, 10, 11, 12, 13, 14, 15, 20, 26, 27, 30, 32, 33, and 37.

3.5.1.7 Community Types of the Boreal Ecoregion. The Boreal Ecoregion is characterized by the presence of white spruce, lodgepole pine (Pinus contorta), jack pine (Pinus banksiana), hybrids of lodgepole and jack pine, black spruce (Picea mariana), and

tamarack (Larix laricina). Numerous understory plant species also serve to characterize this ecoregion. Balsam fir (Abies balsamea) is also a characteristic tree species of the Boreal Ecoregion and only occurs in near-climax stands. This is largely due to numerous fires which have eliminated balsam fir from the vast majority of stands in this ecoregion.

Five major subregions are recognized within the Boreal Ecoregion. These are the Boreal Mixedwoods, Boreal Foothills, Boreal Uplands, Boreal Northlands, and Boreal Subarctic Subregions. The climatic characteristics of each subregion are listed in Table 1.

3.5.1.7.1 Community Types of the Boreal Mixedwood Subregion. The Boreal Mixedwoods Subregion of the Boreal Ecoregion is very extensive and complex. It is characterized by the presence of all of the characteristic species listed in the discussion of the Boreal Ecoregion above (Section 3.5.1.7). The distinctive vegetation characteristic of the Boreal Mixedwoods Subregion is the abundance and usual codominance of aspen (Populus tremuloides) with those conifer tree species. Two other deciduous tree species are also often very abundant (i.e., balsam poplar (Populus balsamifera) and paper birch (Betula papyrifera). Muskegs, bogs, fens, and treed bogs are also very abundant within this subregion.

Many of the CT's found within this subregion represent seral CT's produced by succession following past fires. Fire is a dominant influence upon the plant species composition and cover found within the CT's (see Table 12). Of the 31 CT's recognized in this study a large number are seral. These include the following from Table 12: CT #'s 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 18, 21, 22, 23,24, 25, and 26.

As a result of this diversity caused by fires, major subdivisions within the Boreal Mixedwood Subregion produced by meso-climatic controlling factors are poorly understood. CT diversity caused by parent materials diversity also complicates the picture in recognizing the major subdivisions within this ecological Subregion.

3.5.1.7.2 Community Types of the Boreal Foothills Subregion. The Boreal Foothills Subregion of the Boreal Ecoregion occurs between 823-1067 m elevation. This subregion is characterized by the presence of lodgepole pine and hybrid logepole x jack pine, balsam fir, and hybrids of balsam and subalpine fir (Abies balsamea x A. lasiocarpa), black spruce, aspen, balsam poplar, tamarack, and white spruce. Table 13 lists the dominant CT's found within this subregion. Deciduous tree species are also abundant within this subregion, again due to frequent, past fires. The pine species and their hybrids also occur as dominants (as was the case in the Boreal Mixedwoods Subregion) due to abundant regeneration following fires. These seral CT's found in the Boreal Foothills Subregion include the following from Table 13: #'s 1, 2, 5, 6, 10, 11, 12, and 14.

3.5.1.7.3 Community Types of the Boreal Upland Subregion. The Boreal Uplands Subregion occurs from about 1067-1372 m elevation and borders the Subalpine Ecoregion at its upper elevation limits. This subregion forms a transition between the Boreal Ecoregion and the Subalpine Ecoregion. The Boreal Uplands Subregion is characterized by the presence of hybrid spruce approaching white spruce, lodgepole pine and black spruce. Aspen,

Table 12. BOREAL MIXEDWOOD SUBREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Trees:										
Potr	50	17	47	30	50	50	52	28	25	5
Poba	5	33	4	13	+	1	+	+	+	
Pigl	2	5	4	1	+		10	2	23	20
Pico	1	+								
Bepa	+	7	2	2			+	18		15
Pima		+							4	
Piba									+	15
Abba									+	
PicoXba										
Abla										
Lala										
Shrubs:										
Alcr	2	2		13			2	3	6	
Sabe	1	4			1	1	2	2	1	
Roac	13	8	14	9	10	5	7		7	3
Vied	8	11	4	9	+	+	7	+	3	
Loin	3	7	+	3						
Shca	8	+			1		15	+		
Splu	3	+		4					+	
Amal	1	+	13	1	+				+	5
Cost	1	13	5	1	+	+			+	
Ruid	1	4	2	+	+	1				
Syal	1		1		+				4	
Vamy	1						1	9		38
Atle		11								30
Coco			19							
Prvi			2							
Legr							1	5	7	
Aruu										6
Huto										
Begl										
Anpo										
Chca										
Forbs:										
Coca	7	2	5	3	5	+	27	18	13	11
Libo	2	1	3	1	1		3	8	5	6
Laco	2	+	1	1	+	1	2	1	+	
Rupu	2	11	4	2	1	7			3	

continued...

Table 12 (Continued).

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Maca	1	+	2	1			+	+	+	
Arnu	6	7	17	13	+		10	2	5	10
Frvi	1				1	10				
Mepa	1	3	1	2	1	5				
Minu		+	+	1				+	2	
Gabo	1	+	1	1	1	1	1			+
Rupa				23						
Epan	4	1		9	+	1	4	+		1
Pyas	1		1	1	+	1	+	+		
Pepa	1		1	1	+					
Viam	1						+			
Asco	4		1	4						
Gatr		1					+			
Eqpr		5	1							
Vica			1							
Arco				1						
Smra				4						
Eqar						10	1			
Anca							6			
Ruar							1			
Vavi							8	2	5	17
Lyan								5	4	
Grasses and Sedges:										
Elin	2	2	1				+		1	2
Caca	+				8	5	2	3	+	
Calst	2	2	+	2						
Cryptogams:										
Plsc	1						2	1	32	6
Ptcc	+			+					4	
Hysp	2	+		+	+	+	1	1	24	1
Cl spp.					+	+				5
Pypo					10	1				
Pe spp.					+					
Po spp.										1

continued...

Table 12 (Continued).

Species[1]	Community Type[2]									
	11	12	13	14	15	16	17	18	19	20
Trees:										
Potr	5	2	1	2	5		4	18	2	+
Poba	1	45	85	+		5				
Pigl	23			50	38	26	25		5	
Pico	1						1			
Bepa	1	+	+	+	4	+	1			
Pima					3		2			
Piba						2		7	47	42
Abba	6				+		61			
PicoXba										
Abla										
Lala										
Shrubs:										
Alcr	+			2		4	2		16	
Sabe		1								
Roac	9	+	18	2	4	10	1		5	
Vied	13			7	4	+	12			
Loin	1	+		1	5	+	4			
Shca				+		+				
Splu						+				
Amal	1			+		+			3	
Cost	5	5	6	+	+					
Ruid	1	+	1	+			6			
Syal		+							2	
Vamy									11	6
Alte	+	1	48	+	4					
Coco										
Prvi								9		
Legr	+			+		+				
Aruu						+			22	11
Huto										+
Begl										
Anpo										
Chca										
Forbs:										
Coca	7		1	6	4	6	17			
Libo	11			10	5	7	7		7	
Laoc	+			+		1				
Rupu	5	+		5	4	+	9			

continued...

Table 12 (Continued).

Species[1]	Community Type[2]									
	11	12	13	14	15	16	17	18	19	20
Maca	+		12	3		1	2		5	+
Arnu	5		+	2	4	+	12			
Frvi	1	1		+		+				
Mepa	2	+		2	1	+	6			
Minu	5	+		3	1	+	7			
Gabo		+	+	2	1	+			2	
Rupa										
Epan	1	+	2	2	1	1	1			
Pyas	4	1		+	1	+	6			
Pepa	1			2	1		3			
Viam			+							
Asco	1			1	1	+				
Gatr	+	+								
Eqpr					2					
Vica										
Arco										
Smra			2							
Eqar		1	37							
Ruar			2							
Vavi						+	2		21	2
Lyan	3						6			
Asci	1	+			1					
Pyse	1			+		+	+			
Eqsy							6			
Grasses and Sedges:										
Elin						1				
Caca	5	2		4			25			
Calst					1					
Feov								15		
Ca spp.								9		
Cryptogams:										
Plsc	9			9	20	18	6		5	
Ptcc	3			4	18		10		1	
Hysp	23			20	11	1	16			
Cl spp.								19	6	9
Clmi										62
Pypo										
Pe spp.			+							
Po spp.							+			
Cepu								3		

continued...

Table 12 (Continued).

Species[1]	Community Type[2]										
	21	22	23	24	25	26	27	28	29	30	31
Trees:											
Potr		+		+	3	+					
Poba						+					
Pigl				1	9	+		+			
Pico				30	39	34	11	+			
Bepa		+	7		2		+	+			
Pima			30	+		8	41	45	17	35	12
Piba	26		36						+		
Abba											
PicoXba		35									
Abla					1		+				
Lala				+			+	1		25	26
Shrubs:											
Alcr		1	2		3		+				
Sabe		+	+			+					11
Roac		1		3	4	3	1	+			
Vied					5		+				
Loin					1		1				
Shca		+		2		7	5				
Splu				6	4	1	+				
Amal		+		1	5						
Cost											
Ruid					1						
Syal											
Vamy		1	26	7		4	2				
Alte						+					
Vaca							1				
Prvi		+									
Legr			23			13	8	26	34	33	19
Aruu	9			7		+					
Huto	7										
Begl											12
Anpo										1	
Chca										20	
Forbs:											
Coca		2	5	3	6	4	5	+			
Libo		9		4	3	3	1	+			
Laco		+		1	1						
Rupu					1		+				
Maca		1		2	1	1					

continued...

Table 12 (Continued).

Species[1]	Community Type[2]										
	21	22	23	24	25	26	27	28	29	30	31
Arnu					14						
Frvi		+					+				
Mepa											
Minu					+		+	+			
Gabo		1		+							
Rupa											
Epan		+			+	1	+				
Pyas					1						
Pepa					+	+	+	1			
Viam											
Asco					2	1					
Gatr					1						
Eqpr							+	1			
Vica											
Arco					+		+				
Smra					1						
Eqar								5	1	1	
Anca											
Ruar											
Vavi		5	21	10		3	1	7	28	6	
Lyan					1						
Asci											
Pyse		+			+						
Eqsy											
Geli						1					
Oxmi									12		1
Ruch									3	5	
Metr											2
Grasses and Sedges:											
Elin		5	1	2		2	+				
Caca					+						
Calst				+			+				
Feov	3										
Ca spp.		1						+			
Caaq											3
Cryptogams:											
Plsc		4	31	4	7	62	50	18		13	
Ptcc				+	4	6	12	7	12		
Hysp		3	+	+	5	7	22	14		1	

continued...

Table 12 (Concluded).

Species[1]	Community Type[2]										
	21	22	23	24	25	26	27	28	29	30	31
Cl spp.	12	+		1		+		+			3
Clmi		8	29	14		1	3	6			
Pypo											
Pe spp.	2	+	1	+		2	1	+			
Po spp.	32	3	2			+					
Cepu	41										
Di spp.					+	1	1				
Aupa								+		2	6
Sp spp.								13	59	11	31

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
\+ Cover less than 0.7%.

Plot data from: Dowding (1929); Moss (1932, 1953a); Stringer (1976); Achuff and La Roi (1977); Peterson and Levinsohn (1977); Jaques (1980a); and Carroll and Bliss (1982).

Table 13. BOREAL FOOTHILLS SUBREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Trees:										
Pigl	5	3	34	28		1	1		42	
Pico	35		5	1	41	21	+	+	+	32
Potr	5	42	4	4		3			+	+
Pima	1				3	25	50	+	1	
Abba	+		7	23					2	
Lala								21		
Poba		6	2	1		+			2	
Bepa										+
Shrubs:										
Alcr	3	10	6	1		5			+	7
Vied	8	8	9	14		2			1	2
Roac	8	5	4	2	2	3	+		1	3
Splu	5	5	2		+	1			+	+
Loin	3	1	4	1		2	1		+	+
Sosc	1									
Rupa	3		1							
Amal		1	3							
Legr		1			15	21	15	+	+	+
Vamy		2			4	4				2
Vaca					2					+
Cost			3							
Rila			1						1	
Begl					2			40		
Shca										1
Saca								2		
Vame						2				
Forbs:										
Coca	8	5	7	22	6	6			3	5
Libo	4	4	5	22	5	3			5	6
Arnu	10	3	9	9						+
Rupu	2	2	4	9			1		2	+
Maca	1	1	1	3	4	+				
Epan	3	4	2	1	+	1			+	+
Minu	1	1	2	4		1	2		1	
Arco	2	3	+			+			+	
Pyas	2	3	2	3		+			+	+
Gydr	3		1	6						
Pepa	1	1	3	2	1	1	1		1	+

continued...

Table 13 (Continued).

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Lyan	2			4	1					
Laoc	1	1	1			+				2
Asco	1	5								2
Smra	1		2							
Eqsy	1		1	3						
Stam	1		1	1						
Mepa		1	4	3		+			3	
Vica		1								
Opho			2							
Rupe				6						
Pyse				1	1					+
Vavi					4	4				3
Eqsc							4		+	
Eqar							5		7	
Eqpr									1	
Smtr								6		
Oxmi								2		
Grasses and Sedges:										
Elin		4			+	1			2	4
Caca		5		3	+	+			+	
Ca spp.							5			
Caaq								5		
Cagy								3		
Cryptogams:										
Plsc	16	+	9	9	33	35	10		6	1
Ptcc	8		11	13	5	19	6		8	1
Hysp	5		28	25	4	28	23		22	6
Clmi					10					
Di spp.						1			1	
Pe spp.						+	3			+
Toni							7	2		
Aupa							10	9		
Spwa								26		
Span								48		

continued...

Table 13 (Continued).

Species[1]	Community Type[2]					
	11	12	13	14	15	16
Trees:						
Pigl		15			35	48
Pico[3]					1	2
Potr	2		3	50	5	7
Pima						+
Abba						2
Lala						
Poba			50			+
Bepa					10	
Piba	61	50				
Shrubs:						
Alcr	2	50				
Vied				5	4	22
Roac	6	15	5	5		12
Splu						
Loin			5	1	2	4
Sosc					+	+
Rupa						
Amal						+
Legr						
Vamy	6					
Vaca						
Cost			+			
Rila					2	1
Begl						
Shca	2					
Saca						
Vame						
Aruu	30	6				
Ruid					12	+
Syal		15		5		
Forbs:						
Coca	9		1	8	1	14
Libo	12	6	5			11
Arnu		6	+		16	6
Rupu			5	1	3	9
Maca	9	6	1		+	+
Epan	4		+	+	8	1
Minu			1		1	7
Arco			+	+		

continued...

Table 13 (Continued).

Species[1]	Community Type[2]					
	11	12	13	14	15	16
Pyas			1			1
Gydr					2	+
Pepa			1		3	2
Lyan						+
Laoc		6	1	+	5	1
Asco						
Smra						
Eqsy			1		2	
Stam					12	
Mepa			5	1	+	6
Vica						
Opho					1	
Rupe					23	
Pyse		15				
Vavi	30					
Eqsc		6				
Eqar			1			3
Eqpr						
Smtr						
Oxmi						
Grasses and Sedges:						
Elin						
Caca			5	5	86	2
Ca spp.						
Caaq						
Cagy						
Brci	15	15				
Agca				5		
Cryptogams:						
Plsc		25				
Ptcc	+	9		+	1	15
Hysp						+
Clmi			+	1	37	
Di spp.						
Pe spp.	B					+
Toni				1		

continued...

Table 13 (Concluded).

Species[1]	Community Type[2]					
	11	12	13	14	15	16
Aupa						
Spwa						
Span						
Cl spp.	12					
Pypo			5	5		

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
[3] Includes hybrid Pico x Piba.
\+ Cover less than 0.7%.

Plot data from: Moss (1953a); Achuff and La Roi (1977); Jaques (1978); Holland and Coen (1982); and Archibald et al. (1984).

balsam poplar, and paper birch are much less common than in the previously described Boreal subregions. Whether this is due to climatic influences, reduced fire frequency, or a combination of both is not clearly understood. Table 14 lists the CT's dominant within this subregion. CT's 2-7, inclusive, represent seral CT's produced by regeneration following fires.

3.5.1.7.4 Community Types of the Boreal Northlands Subregion. The Boreal Northlands Subregion develops northward from the Boreal Mixedwoods Subregion. Decreasing temperature and precipitation regimes are characteristic of the Boreal Northlands as compared with the Boreal Mixedwoods. All of the same species are present in the Boreal Northlands Subregion as those found within the Boreal Mixedwoods; however, black spruce and tamarack tend to be much more common in association with extensive bogs, muskegs, and treed muskegs in the Boreal Northlands Subregion. Table 15 lists the dominant CT's presently known from this relatively poorly understood subregion.

3.5.1.7.5 Community Types of the Boreal Subarctic Subregion. The Boreal Subarctic Subregion of the Boreal Ecoregion is very poorly known at the present time. This subregion occupies low elevation (305-1067 m) areas north of 57° N latitude. The CT's presently known from this subregion are listed in Table 16. This list is very incomplete. However, throughout the subregion, CT's dominated by black spruce are the most abundant and are characteristic of the subregion.

3.5.2 Dominant and Common Plant Species of Alberta

Although it is outside the terms of reference of this study to evaluate literature of plant species' sensitivity to acid deposition, it is a basic assumption that inherent differences exist among plant species in their sensivity to acid deposition. Therefore, it is essential that we possess a detailed knowledge of the actual plant species which dominate the cover of the land area to be assessed. The analyses documented in Section 3.5.1 allow the identification of the common and dominant plant species for which significant differences in sensitivity should be expected.

Tables 17 and 18 list these important species. Table 17 lists those species which are abundant throughout wide areas of the Province. Many of these species are important timber species, important browse species for domestic animals and wildlife, important grazing species for domestic animals and wildlife, signifcant ground cover important as watershed stabilizing vegetation, important aesthetic species regarding recreation activities, and offer many other direct and indirect values to human society in Alberta. Table 18 lists the common species found throughout Alberta which are either more restricted in distribution or lower in abundance than those listed in Table 17. All 191 of these species are important in Alberta. There are many other plant species (i.e., about 1,564) known in Alberta; these are all much less abundant and/or restricted in distribution.

3.5.3 Vegetation Map of Alberta

The map of "Vegetation of Alberta" included with this report shows the dominant overstory vegetation cover throughout the Province. The scale of this map (i.e.,

Table 14. BOREAL UPLANDS SUBREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Trees:										
Pico	5	43	43	34	53	36	37	6	7	9
Pima	39	8	1	1	+	1			1	4
Abla	8	1	1	5			1	20		
PienXgl		1	1	+	1	1	1	36		
Pigl									10	19
Abba									36	3
Potr			1	3	2		5			5
Poba							2			
Shrubs:										
Legr	25	19	26	10		7	2		6	3
Vame	6	11	1	17	1	2	2	3	9	
Begl		2								
Emni		2								
Vamy			6	15		2			2	2
Alcr			2	5	23	48	5	1		
Roac			2		5	1	3	2		8
Sosc			1	1	+		3			
Splu			1	2	2	1	2	1		
Vaca			3	2				2	8	1
Rhal				+	+					
Rila					2		1	2		2
Sasc					3					
Vied					4	1	7	2		11
Loin					2		5	4		1
Ruid										3
Forbs:										
Coca	5	6	10	7	6	9	10	7	12	10
Libo	1	2	6	3	5	1	11	7	6	10
Rupe	1	6	3	3	1	4	13	6	28	
Vavi	5	2	15						3	5
Lyan		1	2	2		1	6	1	4	5
Pyse		1		1			1	1	2	2
Arco		2	1	1	1		5	3		
Epan			2	1	6	2	4	1		3
Pepa			2				2	2		2
Stam			1	+	1		6	1	1	
Arla			1							

continued...

Table 14 (Concluded).

Species[1]	Community Type[2]									
	1	2	3	4	5	6	7	8	9	10
Rupu				1	3	1	4	2		4
Gydr					2		7	3		
Arnu					1		1			5
Frvi					1			1		
Laoc					1		1			
Mepa					3		3	2		2
Rupa					3					
Asco					6		1			
Pyas					3	1	5	1		4
Maca					2		1			3
Minu					1	1	1	1		5
Hela					2		2	1		
Stro							8			
Titr							3			
Acru							2	2		1
Smra							2	2		
Vees							1			
Atff							1			
Eqar								1		5
Lyco									2	
Grasses and Sedges:										
Elin			1		4		1	1		
Caca			1		1				1	6
Cryptogams:										
Plsc	55	34	45	35	12	38	18	20	34	6
Ptcc	19	20	18	25	7	23	8	21	38	15
Hysp	14	16	15	16	8		14	23	20	42
Di spp.	1	2		1		1		1	1	1
Pe spp.	2	2	1	3	1	+	6	3		
Cl spp.	1	3		1						
Po spp.			1			1				

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
\+ Cover less than 0.7%.

Plot data from: Moss (1953a); Achuff and La Roi (1977); Jaques (1979); La Roi and Hratiuk (1980); Holland and Coen (1982); and Archibald et al. (1984).

Table 15. BOREAL NORTHLANDS SUBREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]							
	1	2	3	4	5	6	7	8
Trees:								
Pigl	50		15				18	43
Potr	5	+	3		50	50		1
Poba	+							
Bepa	+		+			+	3	11
Pima		50	15	15				
Lala			+	8	+			
Piba[3]					+			
Pico[3]						+		
Abba							55	3
Shrubs:								
Sabe	+	+	+		1	+		
Vied	1		1		1	8	2	9
Roac	1	+	1	+	1	5		4
Shca	1		+	+	10	+		
Emni	+	1		+				
Legr		5	5	10	+	+		
Samy			1	5				
Ri spp.			+	+				
Alte			+	+				
Myga				3				
Arru				5	+			
Begl				3				
Aruu					10	+		
Ruid							4	21
Forbs:								
Coca	8	+	+	3	8	8	27	26
Rupu	+		+			1	2	3
Mepa	+		1	+		+		
Pyse	3		+		+	1		
Pyas	3		1	+	1	7		
Epan	1	+	+	+	1	5		
Eqar	1	+	+	+		+		
Frvi	+				+	+		
Gabo	1		+		1	+		
Pepa	+	5	+	+		1		
Laoc	+	+	+		1	5		
Celi	3							

continued...

Table 15 (Concluded).

Species[1]	Community Type[2]							
	1	2	3	4	5	6	7	8
Eqsy	1		+					
Libo	+		3			10	12	
Vavi	10	5	7	10	8	1	+	
Minu			1					
Ruch				1				
Maca					+	1	1	2
Trbo							2	2
Asci						5		
Asco						1		
Arco						+		
Lyan							8	2
Arnu								14
Grasses and Sedges:								
Agca			5					
Elin			5		8	8		
Caca						5	1	27
Cryptogams:								
Hysp	25	20	20	5	+	+	53	3
Plsc	+	1	5				3	2
Ptcc	+		+				26	1
Di spp.	+							
Aupa		3	+	5				
Pe spp.		1	1	+	+	+		
Sp spp.			+	+				
Cl spp.		5	5	5				
Pypo					5	5		

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
[3] May include hybrids.
+ Cover less than 0.7%.

Plot data from: Moss (1953a); Stringer (1976); Achuff and La Roi (1977); and Carroll and Bliss (1982).

Table 16. BOREAL SUBARCTIC SUBREGION - Vegetation composition and average canopy cover (%) of species for common Community Types.

Species[1]	Community Type[2]					
	1	2	3	4	5	6
Trees:						
Pigl	30				3	38
Potr	1			+	15	+
Poba	2					
Bepa	+					3
Lala	+			+		
Pima		38	38	15	15	+
Pico				+		
Shrubs:						
Sabe	1					
Alte	+					
Vied	1	+			+	3
Roac	1	+		+	+	3
Ruid	2					
Ri spp.	+			+		+
Shca	3					+
Alcr	3					15
Legr	3	3	15	15	+	+
Emni	+	+	+	+	+	
Arru	+					
Vaul			3	+		
Begl				3		
Lepa				3		
Forbs:						
Gabo	+					+
Maco	+					
Laoc	+					
Geli	1					
Arnu	+					
Frvi	+					
Vavi	5	3	3	3	+	+
Libo	1	+				+
Coca	1	3	3	3	3	3
Rupu	+	+				+
Mepa	+	+			+	+
Minu	+	+		+		+
Pyse	+			+	+	+
Pyas	+				+	+
Epan	1				15	
Asco	3					

continued...

Table 16 (Concluded).

Species[1]	Community Type[2]					
	1	2	3	4	5	6
Eqar	5	3			+	+
Eqsy	1					
Eqpr	3					
Eqsc	1	3		+		
Lyan	+			+	3	+
Ruar	+			+	+	+
Ruch				3		
Laoc						+
Grasses and Sedges:						
Elin	5				3	
Caca	+					
Cryptogams:						
Hysp	20	15		+	15	38
Ptcc	+	+				+
Di spp.	+					
Plsc	1	15	15	+		15
Pe spp.	+	+	+	+	+	+
Cl spp.	+		6	6	+	
Sp spp.	+			38		
Hysp			3			
Clmi				38		

[1] See Appendix 7.4 for list of acronyms.
[2] See Table 6 for list of Community Types.
+ Cover less than 0.7%.

Plot data from: Moss (1953a); Lee et al. (1982).

Table 17. Primary plant species found in vegetation community types of Alberta.[1]

2

Abies lasiocarpa
Agropyron caninum
Agropyron dasystachyum
Agropyron smithii
Alnus crispa
Amelanchier alnifolia
Arnica cordifolia
Artemisia frigida
Aralia nudicaulis
Arctostaphylos uva-ursi
Aster conspicuus

Bouteloua gracilis

Carex aquatilis
Calamagrostis canadensis
Calamagrostis rubescens
Calamovilfa longifolia
Carex obtusata
Carex stenophylla
Cladonia mitis
Cladonia spp.
Cornus canadensis
Cornus stolonifera

Danthonia parryii
Distichlis stricta

Elymus innovatus
Empetrum nigrum
Epilobium angustifolium
Equisetum arvense
Equisetum scirpoides

Festuca idahoensis
Festuca scabrella
Fragaria virginiana

Galium boreale
Geum triflorum

Hylocomium splendens

Juniperus communis
Juniperus horizontalis

Koeleria cristata

Larix laricina
Lathyrus ochroleucus
Ledum groenlandicum
Linnaea borealis
Lonicera involucrata
Lycopodium annotinum

Maianthemum canadensis
Menziesia ferruginea
Mertensia paniculata
Mitella nuda

Peltigera aphthosa
Pinus banksiana
Pinus contorta
hybrid *Pinus contorta* x *P. banksiana*
Picea glauca
hybrid *Picea glauca* x *P. engelmannii*
Picea mariana
Pleurozium schreberi
Populus balsamifera
Populus tremuloides
Pseudotsuga menziesii
Pyrola asarifolia

Rhodendron albiflorum
Ribes lacustre
Ribes oxyacanthoides
Rosa acicularis
Rubus idaeus
Rubus pedatus
Rubus pubescens

Salix bebbiana
Salix glauca
Selaginella densa
Sphagnum angustifolium
Sphagnum wahrstorffii
Spiraea lucida
Stipa comata
Stipa spartea
Stipa viridula

continued

Table 17 (Concluded).

Symphoricarpos albus
Shepherdia canadensis

Thalictrum venulosum
Tomenthypnum nitens

Vaccinium caespitosum
Vaccinium membranaceum
Vaccinium myrtilloides
Vaccinium scoparium
Vaccinium vitis-idaea
Valeriana sitchensis
Vibernum edule

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[1] Primary = Species which are dominant or co-dominant; possess a high presence value [i.e., greater than 40%] within micro-plots or a high presence value [i.e., greater than 60% occurrence within all study sites].

[2] Nomenclature follows that of Hitchcock et al. (1969).

Table 18. Secondary plant species found in vegetation community types of Alberta.[1]

Abies balsamea
Acer glabrum
Actaea rubra
Agrostis scabra
Agropyron spicatum
Anemone canadensis
Andromeda polifolia
Arnica latifolia
Arctostaphylos rubra
Aster ciliolatus
Aster foliaceus
Aster laevis
Athyrium filix-femina
Artemisia cana
Atriplex nuttallii

Barbilophozia lycopodioides
Betula glandulosa
Betula papyrifera
Berberis repens
Bromus ciliatus
Bromus inermis spp. *pumpellianus*

Carex concinna
Carex filifolia
Carex heliophila
Carex praegracilis
Calamagrostis montanensis
Cassiope tetragona
Ceratodon purpureus
Chamaedaphne calyculata
Clintonia uniflora

Danthonia intermedia
Drepanocladus revolvens

Elymus canadensis
Equisetum pratense
Equisetum sylvaticum
Erigeron peregrinus
Eurotia lanata

Festuca altiaca
Festuca ovina

Galium triflorum
Geocaulon lividum
Gymnocarpium dryopteris

Heuchera cylindrica
Helictotrichon hookerii
Heracleum lanatum
Hedysarum sulphurescens
Hudsonia tomentosa

Juncus balticus

Larix lyallii
Ledum palustre
Luzula hitchcockii
Lupinus nootkatensis
Lupinus sericeus
Lycopodium complanatum

Menyanthes trifoliata
Mnium spp.
Myrica gale

Oplopanax horridum
Oxycoccus microcarpus

Parnassia fimbriata
Pachystima myrsinites
Phyllodoce empetriformis
Phyllodoce glanduliflora
Pinus albicaulis
Pinus flexilis
Polytrichum juniperinum
Poa sandbergii
Prunus virginiana
Psoralea lanceolata
Ptilium crista-castrensis
Puccinellia nuttalliana
Pylaisia polyantha
Pyrola secunda

Ribes viscosissimum
Rosa arkansana
Rosa woodsii

continued

Table 18 (Concluded).

Rubus arcticus
Rubus chamaemorus
Rubus parviflorus

Salix barclayii
Salix candida
Salix farrae
Salix scouleriana
Smilacina racemosa
Smilacina stellata
Sarcobatus vermiculatus
Sorbus scopulina
Sorbus sitchensis
Solidago spp.
Streptopus amplexifolius
Stipa richardsonii
Streptopus rossii
Symphoricarpos occidentalis

Thuidium abietinum
Tiarella trifoliata
Trientalis borealis
Trollius laxus

Vaccinium myrtillus
Vaccinium uliginosum
Veratrum eschscholtzii
Vicia americana
Viola canadensis
Viola glabella

Xerophyllum tenax

[1] Secondary = Species which are abundant but less so than primary species; possess a high presence value within micro-plots (i.e., are locally abundant, geographically speaking) and occur in less than 40% of all study sites.

1:1,000,000) precludes identifying the individual conifer species found within each delineation for the "Coniferous Forest" and "Mixed Woodlands" map categories (i.e., "5" and "4" map legend units, respectively). However, actual conifer types found within each delineation can be refined as outlined on Table 19. In addition, the vegetation community type or types most common within each map delineation can be identified by referring to Tables 6-16 for each ecoregion or subregion.

3.6 ECOLOGICAL (BIOPHYSICAL) CLASSIFICATIONS OF ALBERTA

Strong and Legatt (1981) have grouped ecosystems of Alberta into broad ecological regions. This work has, as its conceptual basis, the philosophy of Sukachev and Dylis (1964). The recent work of Strong and Leggat (1981) is a reworking, to some extent, of previous ecological analyses which included Alberta.

The first of these previous analyses (Halliday 1937, as modified and enlarged by Rowe 1959, 1972) recognized five "Forest Regions" in Alberta. These are the Boreal Forest, Subalpine Forest, Montane Forest, Grassland and Alpine Tundra Regions. The Boreal Forest Region was further subdivided into eight Forest Sections which include the following: Aspen Grove (B.17), Mixedwood (B.18a), Hay River (B.18b), Lower Foothills (B.19a), Upper Foothills (B.19c), Athabasca South (B.22b), Upper Mackenzie (B.23a), and Northwest Transition (B.27). Thus, the entire Province was subdivided into 12 major forest regions.

The second of these previous analyses (Kojima 1980) recognized nine "Biogeoclimatic Zones" in Alberta. These are the Alpine Tundra, Subarctic Spruce - Willow - Birch, Boreal White and Black Spruce, Engelmann Spruce - Subalpine Fir, Aspen - Lodgepole Pine - White Spruce, Aspen - White Spruce, Interior Douglas-fir, Fescue Grass Prairie and Mixed Grass Prairie Zones. This study subdivided the Engelmann Spruce - Subalpine Fir Zone into four unique subzones. Thus, the entire Province was subdivided into 12 major forest zones.

The study by Strong and Leggat (1981) recognized twelve "Ecoregions" in Alberta. These include the Short Grass, Mixed Grass, Fescue Grass, Aspen Parkland, Montane, Subalpine, Alpine, Boreal Mixedwood, Boreal Foothills, Boreal Uplands, Boreal Northlands, and Boreal Subarctic. This study has been revised slightly by Knapik and Westworth (1984) and by this present study. However, in both of these cases the revisions have been only minor and reflect localized changes to more accurately place the position of the ecoregion lines on the map.

The "Ecoregions" identified by Strong and Leggat (1981) have been used in this study and are identified on the "Vegetation of Alberta" map in this study. In all three of the previous studies and this present study as well, mapping scales are quite small (i.e., 1:6,500,000 in Rowe 1972; 1:1,000,000 in Kojima 1980; 1:1,500,000 in Strong and Leggat (1981); and 1:1,000,000 in this study). Subdivisions of the major ecological regions identified in each of these studies have not been clearly identified or mapped.

However, numerous biophysical studies have been conducted throughout Alberta which characterize the ecosystems found in small portions of the Province. While no attempt has been made to integrate all of these studies, it should be recognized that these studies form a basis upon which future regional subdivisions could be begun.

Table 19. Conifer species found within map delineations found on the "Vegetation of Alberta" - 1:1,000,000 scale.

Map Legend Unit	Conifer Species
4. & 5.1	Hybrid spruce, subalpine fir, whitebark pine, alpine larch
4. & 5.2	Hybrid spruce, subalpine fir, whitebark pine, alpine larch
4. & 5.3	Hybrid spruce, subalpine fir
4. & 5.4	Hybrid spruce, white spruce, subalpine fir, balsam fir, black spruce
4. & 5.5	White spruce, black spruce, balsam fir, tamarack
4. & 5.6	White spruce, black spruce, balsam fir, tamarack
4. & 5.7	White spruce, black spruce, balsam fir, tamarack
4. & 5.8	White spruce, black spruce, tamarack
4. & 5.9	Limber pine, Douglas-fir, hybrid spruce
4. & 5.21	Lodgepole pine, hybrid spruce
4. & 5.22	Lodgepole pine, hybrid spruce
4. & 5.23	Lodgepole pine, hybrid spruce
4. & 5.24	Lodgepole pine, hybrid spruce, black spruce
4. & 5.25	Lodgepole pine, hybrid pine, white spruce, black spruce, tamarack
4. & 5.26	Lodgepole pine, jack pine, hybrid pine, white spruce, black spruce, tamarack
4. & 5.27	Black spruce, white spruce, tamarack
4. & 5.28	Black spruce, white spruce, tamarack
4. & 5.29	Limber pine, hybrid spruce, Douglas-fir, lodgepole pine

4. DISCUSSION

Existing descriptions and mapping of all major biophysical components of ecosystems in Alberta was compiled and analysed in this study (excepting soils). Each of the biophysical components (i.e., macroclimate, bedrock geology, surficial materials, physiography, and vegetation) are important in their own right for the evaluation of potential impacts of acid deposition.

A bedrock geology map was produced which estimates the potential buffering capacity for acid deposition of bedrock types. For aquatic systems this map is important throughout all of Alberta. For terrestrial systems this map is particularly significant where bedrock exists at or within 100 cm of the ground surface and also where colluvial deposits are formed from underlying bedrock. In the case of terrestrial systems, surface bedrock deposits occur extensively throughout extreme northeastern Alberta (The Taxin River Upland Physiographic District), the upper slopes of the Caribou Mountains, the Rocky Mountain Foothills and Rocky Mountains, east of Hanna, and on the lower and mid slopes of the Cypress Hills. In these areas predictions of potential impacts of acid deposition must take bedrock lithology and minerology factors into account. Significant areas with bedrock types possessing low to no potential to reduce acidity of acid depositions occur in northeastern Alberta and throughout the Rocky Mountains and their Foothills. Significant areas with bedrock types possessing unlimited capacity to reduce acidity of acid depositions exist in these same general geographic locations. Extensive areas with high to medium potential to reduce acidity are found in the eastern half of the cultivated section of the prairie and parkland regions south of the North Saskatchewan River and also in a belt 100-120 km wide extending from the Foothills of the Rocky Mountains eastward. The remainder of the Province has bedrock types with low to high potential to reduce acidity; this rating range precludes any accurate statement being made for these extensive areas at the present time. Special future effort could be applied to these areas to evaluate in a more refined way the potential buffering capacity of the bedrock Formations and Members of Formations found in these areas.

The surficial materials map and analysis produced in this study helps to show the extent of major genetic material types. These genetic material types, to be of major use in evaluating potential impacts of acid deposition, must be further evaluated and mapped as regards mineralogical composition, texture, thickness, and depth of pedogenic development.

Vegetation analyses in this study have identified 134 distinct and important community types throughout Alberta. The cover of dominant plant species has been calculated. Those plant species which are abundant both in aerial extent and cover are listed in Table 20. Each of these species could receive special attention regarding sensitivity to acid deposition since they dominate the landscape. The 67 species listed in Table 20 represent 3.8% of the total flora of Alberta.

Each of these biophysical components also form basic parts of distinct ecosystem types. These ecosystem types represent entities which are something different than just the sum of their component parts (Major 1951). Interactions, competition, symbiotic relationships, parasitic relationships, and other processes serve to produce unique ecosystem entities which possess distinct geographical boundaries or major clinal variations. When one of the biophysical components remains relatively constant, one or

Table 20. Dominant plant species of Plant Community Types in Alberta.

Trees:
Abies balsamea
Abies lasiocarpa
Larix laricina
Picea glauca
Picea glauca x P. engelmannii
Picea mariana
Pinus banksiana
Pinus contorta
Pinus contorta x P. banksiana
Pinus flexilis
Populus balsamifera
Populus tremuloides
Pseudotsuga menziesii

Shrubs:
Alnus crispa
Amelanchier alnifolia
Arctostaphylos uva-ursi
Artemisia cana
Berberis repens
Betula glandulosa
Cornus stolonifera
Juniperus communis
Juniperus horizontalis
Ledum groenlandicum
Lonicera involucrata
Menziesia ferruginea
Rhododendron albiflorum
Ribes lacustre
Ribes oxyacanthoides
Rosa acicularis
Rubus parviflorus
Salix bebbana
Salix glauca
Shepherdia canadensis
Symphoricarpos albus
Symphoricarpos occidentalis
Vaccinium membranacum
Vaccinium scoparium
Virburnum edule

Forbs:
Aralia nudicaulis
Artemisia frigida
Cornus canadensis
Epilobium angustifolium
Fragaria virginiana
Galium boreale
Lathyrus ochroleucus
Linaea borealis

Forbs (continued):
Maiathemum canadense
Pyrola asarifolia
Pyrola secunda
Rubus pedatus
Rubus pubenscens
Vaccinium vitis-idaea

Grasses and Sedges:
Agropyron caninum
Agropyron dasystachyum
Agropyron smithii
Bouteloua gracilis
Calamagrostis canadensis
Calamagrostis rubescens
Carex concinna
Carex heliophila
Carex obtusa
Danthonia parrvii
Elymus innovatus
Festuca idahoensis
Festuca scabrella
Koeleria cristata
Stipa comata
Stipa spartea
Stipa viridula

Cryptogams and Lichens:
Cladonia mitis
Equisetum arvense
Hylocomium splendens
Peltigera aphthosa
Pleurozium schreberi
Ptilium crista-castrensis
Selaginella densa

more of the other components often vary significantly across the same area. This factor precludes the simple extrapolation of any observed result across ecosystem boundaries. Another aspect of ecosystems lies in their potential to form an unique entity. For example, in lichen communities, distinct biological units combine to form another entity which possesses unique characteristics of its own. Ecosystem types may represent entities with this basic nature.

The analysis of vegetation community types showed that subdivisions of the established ecoregions of Alberta exist which have not been formally recognized. It is believed that major differences in sensitivity to acid deposition exist between these undefined ecoregion subdivisions. A system to accurately estimate and map potential impacts of acid deposition throughout Alberta will likely not be successful if the individual ecosystem components are evaluated separately. A biophysical approach may lead to a system of accurate and complete potential impact assessment.

For example, correlations of forest productivity with a single biophysical component (i.e., soil parameters) have been shown to be poor indicators and predictors. The factors which do produce significant differences in forest growth and productivity are either too subtle, ephemeral, and/or complex to identify from pedological factors alone (Kirstein 1929; Wiedman 1934; Sisam 1938; Lutz and Chandler 1946; Gates et al. 1956; Zinke 1959; Daubenmire 1961, 1973; Phillips and Markley 1963; Damman 1964; Covell and McClurkin 1967; Ellenberg 1967; Broadfoot 1969; Youngberg and Dahms 1970; and Shetron 1972). On the other hand, numerous studies have shown that good correlations exist between forest productivity and biophysical classifications within many diverse ecosystems (Cajander 1926; Heimberger 1934; Arnborg 1950; Westveld 1953; Linteau 1955; Leaf 1956; Daubenmire 1961, Hodgkins 1961; Glew 1963; Williamson 1963; Jameson 1965; Roe 1967; Daubenmire and Daubenmire 1968; Carmean 1972; Moir 1972; Henderson et al. 1977; Pfister et al. 1977; Layser and Schubert 1979; Moir and Ludwig 1979; Hoffman and Alexander 1980, 1983; Steele et al. 1981, 1983; Youngblood and Mueggler 1981; Mueggler and Campbell 1982; and Hanks et al. 1983).

Not only can forest productivity be predicted and understood through correlations with biophysical classifications but workers have shown that other ecological relationships can be predicted and understood this way as well. Tree regeneration and reforestation potential (Anderson 1961; Glew 1963; Damman 1964; Mueller-Dombois 1964; Franklin et al. 1970; and Green et al. 1984), disease susceptibility in forest stands (Daubenmire 1961; Van Arsdel 1961; Roe and Amman 1970; and Smith 1972), potential for insect attack of forest stands (Bess et al. 1947; Johnson et al. 1963; Roe and Amman 1970; and Mason and Tigner 1972), susceptibility of trees to windthrow (Day 1950), predicting wildlife browse production (Daubenmire and Daubenmire 1968), and predictions of grass forage production (Jaques 1979; Mueggler and Stewart 1980) are all better understood when correlated with biophysical classification.

It has been shown recently in Alberta that soil parameters can be used to predict only 24% of the variability in forest productivity, while using full biophysical parameters accounted for 66% (Corns and Pluth 1984). As Corns and Pluth show,

> "vegetation attributes... can account for significant amounts of the variability in western lodgepole pine and white spruce mean annual increment and site index. Individual plant species or species groups may reflect subtle environmental characteristics important to tree growth that are not readily discernible from an examination of other physical site attributes" (Corns and Pluth 1984, p. 24).

This study quantitatively underscores for Alberta forest ecosystems what has been understood concerning the value of biophysical classifications throughout the Northern Hemisphere since the pioneering work of Cajander (1926). An integrated biophysical approach to acid deposition impact assessment will produce the best possible understanding of the potential problem and highest risk areas.

5. RECOMMENDATIONS

Two broad recommendations have developed out of this present work. These are:

1) to produce an integrated biophysical analysis and mapping at the ecodistrict level for Alberta or portions of it, and
2) to assess these ecodistricts as to their sensitivity to acid deposition.

The first recommendation is given based upon the hypothesis that individual components of the environment should not be assessed for sensitivity to acid deposition in isolation from one another. Assessments based upon one or another of the biophysical components alone will not allow for the most accurate extrapolation of potential impacts over a very wide geographic area. Ecodistricts should be identified and mapped at a small scale through the combined efforts of a team comprised of a climatologist, soils/surficial geologist, and plant ecologist. The methodology should follow that described in detail by the British Columbia Ministry of Environment (Walmsley et al. 1980).

The ecodistrict mapping should utilize existing information and maps only. The bedrock geology map of Green (1972), surficial geology maps of this Acid Deposition Research Program study (Campbell 1986), physiographic map of Pettapiece (1985), soils map of Lindsay (in prep.), vegetation map of this Acid Deposition Research Program study (Jaques 1986), and all available ecodistrict mapping of the Alberta Energy and Natural Resources, Resource Evaluation and Planning Division should be used as the basis for ecodistrict boundaries. Each ecodistrict should be characterized as to known biophysical parameters and their statistical variability.

The second recommendation involves developing and applying a sensitivity rating for acid deposition and requires several steps. The first step involves the identification of important factors and factor interactions which are known or thought to be significant in determining sensitivity to acid deposition. Following this, each ecosite defined in the ecodistrict mapping should be rated for potential sensitivity to acid deposition based upon a mutually agreed upon composite ranking system for each of the factors identified in step 1. Available quantitative data for each factor must be used for this ranking system for each ecodistrict. Finally, field verification of the sensitivity ranking system should be checked on a reasonable number of important ecodistricts using a mutually agreeable measurement(s) of acid deposition impact. Perhaps measures of mean annual wood production (basal area) and/or foliage sulphur content could be used at the ecologically analogous test sites established within each test ecodistrict. Once the field verification has been completed and analysed, the sensitivity ranking system should be revised where necessary. The revised ranking system should then be applied to all ecodistricts across the Province where data are adequate to assess potential impacts from acid deposition.

At the outset of implementing these recommendations, a team of co-operating scientists should be formed to collaborate on establishing actual technical scope and terms of reference for accomplishing both recommendations.

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7. APPENDICES

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7.4 LIST OF ACRONYMS FOR PLANT SPECIES OF ALBERTA COMMUNITY TYPES.

Abba = *Abies balsamea*
Abla = *Abies lasiocarpa*
Acgl = *Acer glabrum*
Acru = *Actaea rubra*
Agca = *Agropyron caninum*
Agda = *Agropyron dasystachyum*
Agsc = *Agrostis scabra*
Agsm = *Agropyron smithii*
Agsp = *Agropyron spicatum*
Alcr = *Alnus crispa*
Alte = *Alnus tenuifolia*
Amal = *Amelanchier alnifolia*
Anca = *Anemone canadensis*
Anpa = *Anemone patens*
Anpo = *Andromeda polifolia*
Arca = *Artemisia cana*
Arco = *Arnica cordifolia*
Arfr = *Artemisia frigida*
Arla = *Arnica latifolia*
Arnu = *Aralia nudicaulis*
Arru = *Arctostaphylos rubra*
Aruu = *Arctostaphylos uva-ursi*
Asci = *Aster ciliolatus*
Asco = *Aster conspicuus*
Asfo = *Aster foliaceus*
Asla = *Aster laevis*
As spp. = *Aster* species
Atff = *Athyrium filix-femina*
Atnu = *Atriplex nuttallii*

Baly = *Barbilophozia lycopodioides*
Begl = *Betula glandulosa*
Bepa = *Betula papyrifera*
Bere = *Berberis repens*
Bogr = *Bouteloua gracilis*
Brci = *Bromus ciliatus*
Brin = *Bromus inermis*

Caaq = *Carex aquatilis*
Caca = *Calamagrostis canadensis*
Caco = *Carex concinna*
Cafi = *Carex filifolia*
Cagy = *Carex gynocrates*
Cahe = *Carex heliophila*
Calo = *Calamovilfa longifolia*
Camo = *Calamagrostis montanensis*
Caob = *Carex obtusata*
Capr = *Carex praegracilis*
Caru = *Calamagrostis rubescens*
Calst = *Calamagrostis stricta*
Cast = *Carex stenophylla*

Ca spp. = *Carex* species
Cate = *Cassiope tetragona*
Cepu = *Ceratodon purpureus*
Chca = *Chamaedaphne calyculata*
Clmi = *Cladonia mitis*
Cl spp. = *Cladonia* species
Clun = *Clintonia uniflora*

Dain = *Danthonia intermedia*
Dapa = *Danthonia parryii*
Di spp. = *Dicranum* species
Dist = *Distichlis stricta*
Drre = *Drepanocladus revolvens*

Elca = *Elymus canadensis*
Elin = *Elymus innovatus*
Emni = *Empetrum nigrum*
Epan = *Epilobium angustifolium*
Eqar = *Equisetum arvense*
Eqpr = *Equisetum pratense*
Eqsc = *Equisetum scirpoides*
Eqsy = *Equisetum sylvaticum*
Erpe = *Erigeron peregrinus*
Eula = *Eurotia lanata*

Feal = *Festuca altaica*
Feid = *Festuca idahoensis*
Feov = *Festuca ovina*
Fesc = *Festuca scabrella*
Frvi = *Fragaria virginiana*

Gabo = *Galium boreale*
Gatr = *Galium triflorum*
Geli = *Geocaulon lividum*
Getr = *Geum triflorum*
Gydr = *Gymnocarpium dryopteris*

Hecy = *Heuchera cylindrica*
Heho = *Helictotrichon hookerii*
Hela = *Heracleum lanatum*
Hesu = *Hedysarum sulphurescens*
Huto = *Hudsonia tomentosa*
Hysp = *Hylocomium splendens*

Juba = *Juncus balticus*
Juco = *Juniperus communis*
Juho = *Juniperus horizontalis*

Kocr = *Koeleria cristata*

Lala = *Larix laricina*
Laly = *Larix lyalli*
Laoc = *Lathyrus ochroleucus*

Legr = *Ledum groenlandicum*
Lepa = *Ledum palustre*
Liho = *Linnaea borealis*
Loin = *Lonicera involucrata*
Luhi = *Luzula hitchcockii*
Luno = *Lupinus nootkatensis*
Luse = *Lupinus sericeus*
Lyan = *Lycopodium annotinum*
Lyco = *Lycopodium complanatum*

Maca = *Maianthemum canadensis*
Mefe = *Menziesia ferruginea*
Mepa = *Mertensia paniculata*
Metr = *Menyanthes trifoliata*
Minu = *Mitella nuda*
Mn sp. = *Mnium* species
Myga = *Myrica gale*

Opho = *Oplopanax horridum*
Oxmi = *Oxycoccus microcarpus*

Pafi = *Parnassia fimbriata*
Pamy = *Pachystima myrsinites*
Peap = *Peltigera aphthsa*
Pe spp. = *Peltigera* species
Phem = *Phyllodoce empetriformis*
Phgl = *Phyllodoce glanduliflora*
Pial = *Pinus albicaulis*
Piba = *Pinus banksiana*
Pico = *Pinus contorta*
PicoXba = hybrid Pico and Piba
Pifl = *Pinus flexilis*
Pigl = *Picea glauca*
PiglXen = hybrid PiglX*Picea engelmannii*
Pima = *Picea mariana*
Plsc = *Pleurozium schreberi*
Poba = *Populus balsamifera*
Poa spp.= *Poa* species
Poju = *Polytrichum juniperinum*
Posa = *Poa sandbergii*
Po spp. = *Polytrichum* species
Potr = *Populus tremuloides*
Prvi = *Prunus virginiana*
Psla = *Psoralea lanceolata*
Psme = *Pseudotsuga menziesii*
Ptcc = *Ptilium crista-castrensis*
Punu = *Puccinellia nuttalliana*
Pyas = *Pyrola asarifolia*
Pypo = *Pylaisia polyantha*
Pyse = *Pyrola secunda*

Rhal = *Rhodendron albiflorum*
Rila = *Ribes lacustre*
Riox = *Ribes oxyacanthoides*
Ri spp. = *Ribes* species
Rivi = *Ribes viscosissimum*
Roac = *Rosa acicularis*
Roar = *Rosa arkansana*
Ro spp. = *Rosa* species
Rowo = *Rosa woodsii*
Ruar = *Rubus arcticus*
Ruch = *Rubus chamaemorus*
Ruid = *Rubus idaeus*
Rupa = *Rubus parviflorus*
Rupe = *Rubus pedatus*
Rupu = *Rubus pubenscens*

Saba = *Salix barclayii*
Sabe = *Salix bebbiana*
Saca = *Salix candida*
Safa = *Salix farriae*
Sagl = *Salix glauca*
Sasc = *Salix scouleriana*
Save = *Sarcobatus vermiculatus*
Sede = *Selaginella densa*
Smra = *Smilacina racemosa*
Smst = *Smilacina stellata*
Sosc = *Sorbus scopulina*
Sosi = *Sorbus sitchensis*
So spp. = *Solidago* species
Span = *Sphagnum angustifolium*
Sp spp. = *Sphagnum* species
Spwa = *Sphagnum warnstorffii*
Splu = *Spiraea lucida*
Stam = *Streptopus amplexifolius*
Stco = *Stipa comata*
Stri = *Stipa richardsonii*
Stro = *Streptopus rossii*
Stsp = *Stipa spartea*
Stvi = *Stipa viridula*
Syal = *Symphoricarpos albus*
Syoc = *Symphoricarpos occidentalis*
Shci = *Shepherdia canadensis*

Thab = *Thuidium abietinum*
Thve = *Thalictrun venulosum*
Titr = *Tiarella trifoliata*
Toni = *Tomenthypnum nitens*
Trbo = *Trientalis borealis*
Trla = *Trollius laxus*

Vaca = *Vaccinium caespitosum*
Vame = *Vaccinium membranaceum*
Vamrt = *Vaccinium myrtillus*
Vamy = *Vaccinium myrtilloides*
Vasc = *Vaccinium scoparium*

Vasi = *Valeriana sitchensis*
Vaul = *Vaccinium uliginosum*
Vavi = *Vaccinium vitis-idaea*
Vees = *Veratrum eschscholtzii*
Viam = *Vicia americana*
Vica = *Viola canadensis*
Vied = *Viburnum edule*
Vigl = *Viola glabella*

Xete = *Xerophyllum tenax*

MAPS
NOT
FILMED

CARTES
OMISES